AMERICAN TRANSMISSION COMPANY
THE ENERGY ACCESS COMPANY

Scope Document
North Madison to Huiskamp 138 kV Line
In-Service: June 2008

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Transmission Planning and Service
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Executive Summary

Transmission studies conducted by ATC Planning analyzing 2009 to 2014 summer peak conditions indicate that the thermal loading on several 69 kV and 138 kV lines in the Madison area will exceed their limits if the existing system is not reinforced with a new 138 kV source from the North. The 2009 analysis found that several contingencies caused loading on the existing Ruskin-Blount and North Madison-Dane lines to exceed safe operating limits.

To address the system reliability issue identified above, Planning is recommending construction of a 138 kV line from North Madison-Huiskamp plus a new 138 kV bus at Huiskamp. This project would provide numerous benefits for the Madison metro area and Dane County, including:

- Prevents overloading of the lines in the area
- supports load growth in the area
- Improves the transfer (import) of power in Dane County
- Reduce ATC system losses by over 3 MW during peak loading periods
- Eliminates the need for pre-contingency re-dispatch of diesel or other expensive generation in Dane County

Planning recommends that ATC construct the 138 kV line from North Madison-Huiskamp as follows:

i. Construct a new North Madison-Huiskamp 138 kV overhead line on about 8.5 miles new right-of-way.
ii. Install a 138 kV breaker at North Madison
iii. Construct a new 138 kV bus at Huiskamp (at the existing site)
iv. Install a 187 MVA, 138/69 kV transformer at Huiskamp
v. Install a 69 kV breaker at Huiskamp 69 kV bus
vi. Upgrade terminal equipment as needed (listing is provided in Appendix B: Table B1 and Table B2)

The recommended project will require a Certificates of Public Convenience and Necessity (CPCN) application. The estimated cost of phase 1 is about $10.5 million in 2008 dollars. All dollar amounts in this document are in 2008 dollars.

1. Introduction

Higher than average electric load growth in Dane County, particularly to the west and south of the City of Madison, is creating a need for additional high capacity supplies into the study area (Figure 2). This growth will soon adversely effect transmission system operation and reliability in the study area. After examining non-transmission alternatives, ATC Planning has determined that transmission reinforcements are needed in the study area.

In addition to the recommended projects in this document, ATC already has various transmission system reinforcements in the process including the following:

- Conversion of the Columbia-North Madison 138 kV circuit to 345 kV operation
- Rebuild of the North Madison substation (345 kV and 138 kV ring busses) (2006)
- North Madison 345/138 kV transformer replacement (2006)
- Rebuild of the Kegonsa-McFarland-Femrite 69 kV line (complete) and conversion to 138 kV operation (2007)
- Conversion of the Sycamore-Sprecher 69 kV line to 138 kV operation(2007)
- Construction of a new Femrite-Sprecher 138 kV line (2007)
- Fitchburg 138/69 kV transformer replacement (complete)
- Construction of a new Fitchburg to Montrose 138 kV line (2008-2009)

2. Project Description

The conceptual one-line of the recommended project is provided in Figure 1 and will consist of the following components:

i. Construct a new North Madison-Huiskamp 138 kV overhead line on about 8.5 miles of new right-of-way
ii. Install a 138 kV breaker at North Madison
iii. Construct a new 138 kV bus at Huiskamp (on an existing site)
iv. Install a 138/69 kV transformer at Huiskamp
v. Install a 69 kV breaker at Huiskamp 69 kV bus
vi. Upgrade terminal equipment as needed (Appendix B, Table B1 and Table B2)

North Madison to Huiskamp 138 kV Line

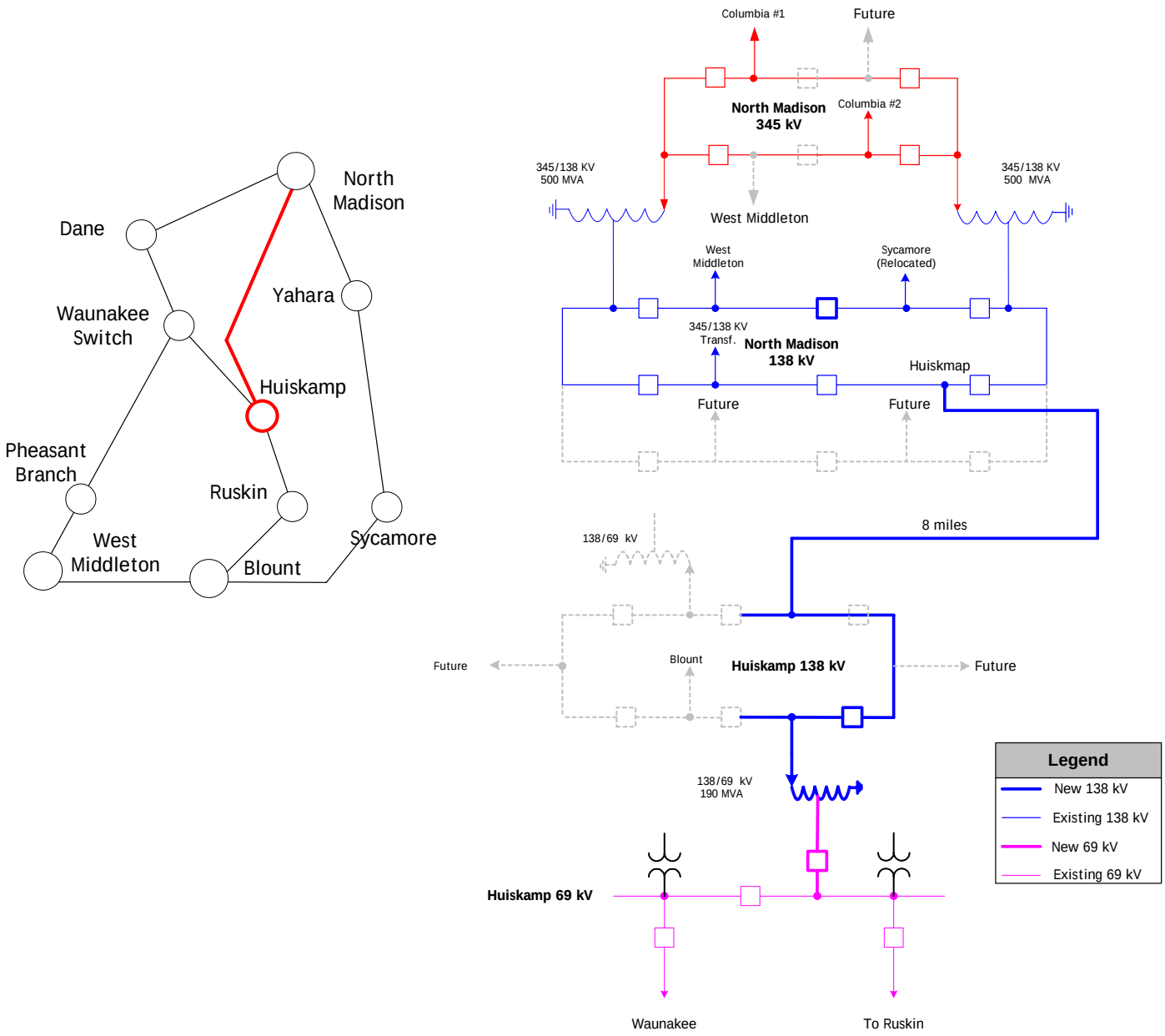


Figure 1- North Madison-Huiskamp 138 kV line

3. Project Capital Cost

i. North Madison-Huiskamp 138 kV line ($6,023,000)
ii. Transmission Work at North Madison ($530,00)
iii. Transmission Changes at Huiskamp 138 kV and 69 KV ($3,320,397)
iv. Pre-certification ($570,201 M)

The preliminary estimate for above work is about $10,443,598 in 2008 dollars.

4. Licensing requirements

Under existing Public Service Commission of Wisconsin regulations, projects involving construction of one mile or more of 100 kV or above transmission line require that a Certificate of Public Convenience and Necessity (CPCN) be obtained. ATC will be required to file a CPCN application for this project.

5. Project Schedule

Project Activity	Preliminary Date
Authorize pre-certification budget	Complete
Start Route Specific Outreach	On-going
Open houses	On-going
Complete CPCN scope definition	08/1/2005
Start application preparation and environment surveys	08/1/2005
PA complete/ATC executive review	10/28/2005
File CPCN Application	01/15/2006
Receive PSCW Approval	01/15/2007
Begin Construction	
Facilities in Service	6/1/2008

6. Project Need

Higher than average electric load growth in Dane County, particularly to the west and south of the City of Madison, is creating a need for additional high capacity supplies into the Dane County area. The demand is projected to grow at a rate of 3.75% a year between 2004 and 2012 compared to 2.5% a year for the entire ATC service area.

Dane County does not have enough local generation in the county to support this demand; therefore Dane County depends on import of power for about 50% of its needs.

ATC, in concert with public advocacy groups and local utilities, has investigated the potential for non-transmission alternatives: new base or peaking generation facilities, energy efficiency measures (conservation), load control (demand side management) and distributed generation resources. The Dane County Energy Initiative has concluded that these measures are not sufficient to keep up with the higher than average load growth in Dane County. It is therefore critical that ATC implement transmission reinforcements to maintain electric service reliability in the Madison area.

6.1 Short-Term Need

As shown in Figure 2, both Blount-Ruskin 69 kV lines will carry 64 MW, about 35 percent of the study area demand. A combination of factors including: load increase in the area, new generation at West Campus and additional transmission system reinforcements will contribute to increased flows on the Blount-Ruskin lines. These 69 kV lines have load-carrying capability of 50 MVA each and will be carrying about 32 MW (study area power factor is close to unity) each under normal intact system conditions. For the loss of one of these lines most of the flow will shift to the adjacent line and result in a severe overload. The adjacent line either would be tripped off-line or taken out of service to protect the line. With both of the Blount-Ruskin circuits out of service, the North Madison-Dane and West Middleton-Pheasant Branch 69 kV lines may overload as well. With these lines overloaded, the next step to prevent a wide area outage would be to selectively shed load.

In addition to thermal overloads during summer peaks, the present system configuration makes it difficult to schedule routine or emergency maintenance on any of the three sources that supply the study area. When one of these three sources is taken out of service for maintenance, the remaining sources are at post- contingency overloads. Therefore maintenance is less likely to be done, which will degrade the reliability of the area.

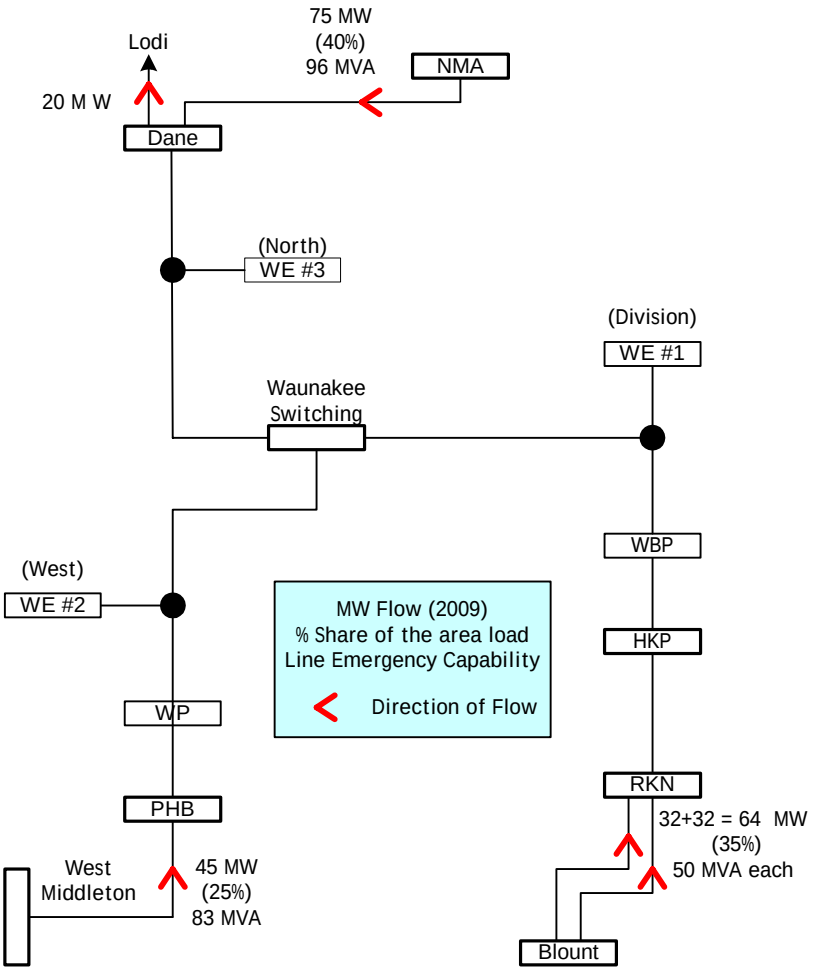


Figure 2 - Study area line flows under normal conditions in 2009 model

6.2 Long-Term Need

Dane County depends heavily on imports via the external bulk power delivery points at Rockdale and North Madison substations.

The addition of a 138 kV circuit from North Madison Substation to Huiskamp Substation will help to mitigate stress on the North Madison-ABS 138 kV line, the North Madison 138/69 kV transformer, the North Madison-Dane 69 kV line and the two Christiana-Kegonsa 138 kV lines. These are all key resources for importing power into Dane County. The addition of this new line also adds geographic diversity for bulk power transmission into Dane County from the North Madison substation. Future projects are planned to address reliability on the 345 kV system feeding the two main import sources.

7. Decision Matrix

In addition to the cost and immediate needs, projects are selected based on the robustness of their overall performance, to maximize the benefits of transmission system over time. Factors that were used to evaluate and compare the recommended project with alternatives are listed in Table 1. The details for each alternative are provided in the later sections.

Table 1 - Decision Matrix

Study Year →	**2009**						**2012**					
Dane County Generation →	**775 MW**						**833 MW**					
Scenario # →	10a-09-04	11a-09-04	16a-09-04	12a-09-04	13a-09-04	15-09-04	40a-12-03	43a-09-03	42a-12-03	41a-12-03	46a-12-03	45a-12-03
Alternative # → Performance ↓	B	N-W	N-H[1]	Y-W	S-R	N-D-W[4]	B	S-R	Y-W	N-W	N-H	N-D-W
Normal Voltages %	99.7	100	100	100	99.9	100	96.8	96.8	97.0	97.8	97.7	97.9
Contingency Voltages %	98.4	99.3	98.9	99.3	98.4	98.5	92.5	92.7	92.6	95.4	95.6	95.4
Units Var Consumption %	60.3	58.1	44.4	46.9	59.6	51.1	98.6	98.4	98.4	96.9	96.4	96.4
Common mode failures	Na	Na	Na	Na	Na	Na	1,2	1,2	1,2	1,2	1,2	1,2
Voltage Stability Limits MW	1524	1555	1564	1524	1524	1559	1541	1541	1541	1596	1606	1596
Year of Growth	3	4	4	3	3	4	1	1	1	2	2	2
Thermal Relief	2X	4X	4X	3X	2X	4X	2X	2X	2X	3X	4X	2X
Increase in import Capability MW	0	518	555	0	0	371	0	0	29	414	409	423
System Losses MW	352	349	349	351	352	349	402	402	401	398	398	398
20-Year Loss Savings ($ M) [2]	Na	15.72	15.72	5.25	0	15.72	Na	0	4.43	17.74	17.74	17.74
Capital Cost ($M) [3]	Na	14.14	10.81	10	7.5	18.99	NA	10	7.5	14.14	10.81	18.99
Future Expansion	2X	4X	3X	2X	2X	3X	2X	2X	2X	4X	2X	3X
Reliability and Operating flexibility	2X	4X	4X	3X	3X	2X	2X	3X	3X	4X	4X	2X
Count of Preferred Outputs	**1**	**9**	**9**	**2**	**2**	**5**	**0**	**0**	**1**	**8**	**8**	**7**

B: Base Case
N-W: North Madison Waunakee 138 kV line
N-H: North Madison-Huiskamp
Y-W: Yahara –Waunakee 69 kV line
S-R: Sycamore-Ruskin 69 kV line
N-D-W: North Madison-Dane-Waunakee conversion existing 69 kV line to 138 kV
[1] Recommended Project
[2] Present value of 20-year capacity and energy loss savings in 2008 dollars
[3] Total cost include cost to ATC and local utilities
[4] Conversion between N. Madison to Dane and 69 kV and 138 kV double circuited between Dane to Waunakee

4X ~ Good 3X ~ Fair 2X ~ Poor | Shaded Area | Preferred Output

An unbiased ranking of the projects from Table 1 indicates superior performance by the recommended project – North Madison – Huiskamp or “N-H” -- as well as one of the North Madison to Waunakee 138 kV alternative. The close comparison of these two finalists reveals that the recommended project (N-H) will cost about 3 million dollars less than its competition (N-W).

Development of this project was initially driven by thermal overloads on Blount-Ruskin 69 kV lines and 69 kV outlets from the North Madison Substation. To some extent all of the projects (recommended and alternatives) resolve-loading issues for the study year (2009) but in 2012 the overloads on 69 kV outlets from North Madison and Blount re-emerge with the alternatives (Section 9: Table 5), but not with the recommended project (N-H). This shows that North Madison to Huiskamp provides the more robust performance over the long run.

This project was not designed to address the potential for voltage collapse due to common mode failure of two Columbia-North Madison 345 kV lines or two Christian-Kegonsa 138 kV lines. A separate effort to address common mode failure and load growth issues beyond 2012 is underway.

Based on its overall performance and cost effectiveness, ATC Transmission Planning recommends construction of the North Madison-Huiskamp 138 kV line.

8. Alternatives

8.1 Alternative #1: Null Alternative

As shown in Figure 2, both Blount-Ruskin 69 kV lines will carry 64 MW, about 35 percent of the study area demand. A combination of factors, including load increase in the area, new generation at West Campus and additional on-going reinforcements, will contribute to increase the flow on the Blount-Ruskin lines. These 69 kV lines have load-carrying capability of 50 MVA each and will be carrying about 32 MW (study area power factor is close to unity) each under normal conditions. For the loss of one of these lines most of the flow will shift to the adjacent line and result in overloads (See Section 9:Table 2, Table 3, Table 4, Table 5 and Table 13). The adjacent line either would be tripped off-line or taken out of service to protect the line. With both of the Blount-Ruskin circuits out of service, the North Madison-Dane and West Middleton-Pheasant Branch 69 kV lines may overload as well. With these lines overloaded, the next step to prevent a wide area outage would be to selectively shed load.

This vulnerability would further increase when the two Blount-Ruskin lines are replaced by a single underground circuit according to a proposal made by ATC to the City of Madison (see Appendix A). The underground cables are typically very reliable but when failure does occur, fault location and repair takes much longer than in the case of overhead lines. The potential for a long-term unplanned outage increases the risk of a catastrophic outage should another circuit fail while the underground cable is being repaired. While the failure of an underground circuit coupled with another simultaneous failure goes beyond single contingency planning, this is not a new concept for major metro systems where significant portions of the transmission system are underground. For example, downtown Milwaukee and downtown Chicago use double contingency planning to offset the risk exposure associated with long duration outages to repair underground circuits.

The number of contingencies that could cause overloads on the Blount-Ruskin lines and the North Madison-Dane line will increase as listed in thermal analysis results for year 2010 and 2014 (Section 9: Table 2, Table 5 and Table 13). The higher than normal load growth in the area, prior to year 2014 will cause thermal overloads on the North Madison to Dane 69 kV line under system intact conditions (Section 9: Table 13) compared to contingency conditions in 2009. As loads increase the number of overloaded elements will continue to grow (Section 11: Table 13). Without robust system reinforcement, reliable operation of the present system will become more difficult and risk of widespread long-duration outages will increase.

Dane County depends on power imports for about 50% of its demand on a peak day. There is no capacity on the present transmission system for additional imports beyond what is already modeled in the base case. In order to relieve the overloaded North Madison-Dane 69 kV line, the recommended project will allow increased imports by providing an additional path from the North Madison substation.

Risks associated with the null alternative can be summarized as follows:

- High risk of overloads on Blount-Ruskin lines
- Potential for cascading failures
- Lack of import capability

- Difficulty to perform routine maintenance
- Inability to meet the load serving needs of Dane County
- Increase in both the magnitude and number of overloaded elements
- High risk of dispatching, high cost generation
- Increased air pollution due to running diesel generation for redisptach

For the above reasons, the null alternative is considered unfeasible and is therefore dismissed from further consideration.

8.2 Alternative #2: North Madison-Waunakee 138 kV line

This alternative's performance is comparable to the recommended project; however the project cost would be considerably higher. The higher cost is primarily driven by the need for a new substation site at Waunakee with 138 kV and 69 kV buses. In contrast, the recommended project will terminate at Huiskamp substation which already has a 69 kV bus and was designed to have room for the addition of a 138 kV bus.

The conceptual one-line of this alternative is shown in Figure 3 below. It consists of the following:

i. Construct a new North Madison-Huiskamp 138 kV overhead line on about 8.2 miles of new right-of-way
ii. Install a 138 kV breaker at North Madison
iii. Construct a new 138 kV bus at Waunakee on a new site
iv. Install a 138/69 kV transformer at Waunakee
v. Construct a new 69 kV bus at Waunakee on a new site
vi. Re-route existing Waunakee Switching to Huiskamp 69 kV line through new Waunakee substation.

The preliminary cost estimate for the alternative 2 is 14 million dollars.

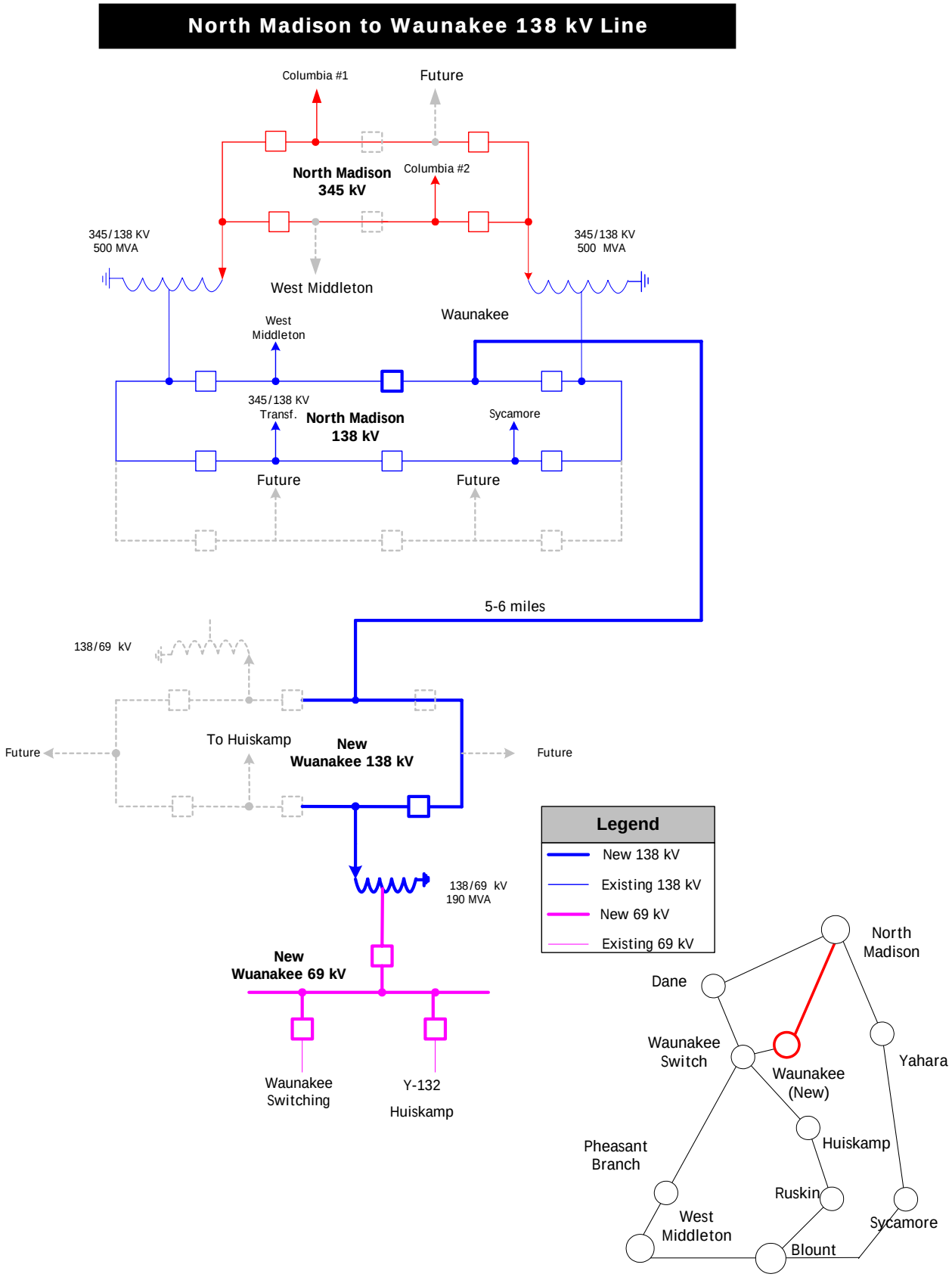


Figure 3 - North Madison-Waunakee 138 kV line

8.3 Alternative #3: North Madison-Dane-Waunakee (conversion from 69 to 138 kV operation)

This alternative will eliminate the need for new right-of-way and meets the system needs in 2009 but does so at significantly higher cost without any long-term advantage. It will cost about eight million dollars more than the recommended project. Some of the drawbacks include following:

- Requires 138 kV bus at Dane as well as 138 kV and 69 kV buses at Waunakee
- Requires conversion of a line that can not be taken out of service
- Requires a portion to be double circuited with an existing 69 kV line that can not be taken out of service
- It will not introduce a new source in the area (due to conversion on line between North Madison-Dane) and thus will not adequately address future load growth
- Overloads will re-emerge on Blount-Ruskin lines in later years

The conceptual one-line of this alternative is shown in Figure 4 below. It consists of the following:

i. Convert exiting North Madison-Dane 69 kV line to 138 kV operation on about 5 miles of new right-of-way
ii. Install a 138 kV breaker at North Madison
iii. Build a new 138 kV bus at Dane
iv. Install a 138/69 kV transformer at Dane
v. Rebuild about 6 miles of existing Dane-Waunakee 69 kV line for a double circuit to hold new Dane-Waunakee 138 kV line
vi. Build a new 138 kV bus in Waunakee on a new site
vii. Build a new 69 kV bus in Waunakee on new site
viii. Install a 138/69 kV transformer at Waunakee
ix. Re-route existing Waunakee Switching to Huiskamp 69 kV line through new Waunakee substation.

The preliminary cost estimate for the alternative 3 is 19 million dollars.

Why A New 138 kV Bus Is Necessary for the Dane Substation?

The Dane substation with 69 kV bus is connected to North Madison, Waunakee and Lodi by 69 kV lines. And further north the Lodi load is supplied by two 69 kV sources: a five mile long 69 kV line from Dane and an approximately 10 miles long line 69 kV line from Dam Heights. Under normal conditions most of the Lodi load is served from Dane.

A configuration that would leave Dane 69 kV bus without a connection to North Madison or Waunakee would result in low voltages at Dane Substation and in Lodi for single contingencies. This type of configuration can result if either of the 69 kV lines from North Madison or Waunakee to Dane is converted to 138 kV without establishing a 138 kV bus with a 138/69 kV transformers at Dane Substation.

North Madison to Dane to Waunakee 138 kV Line

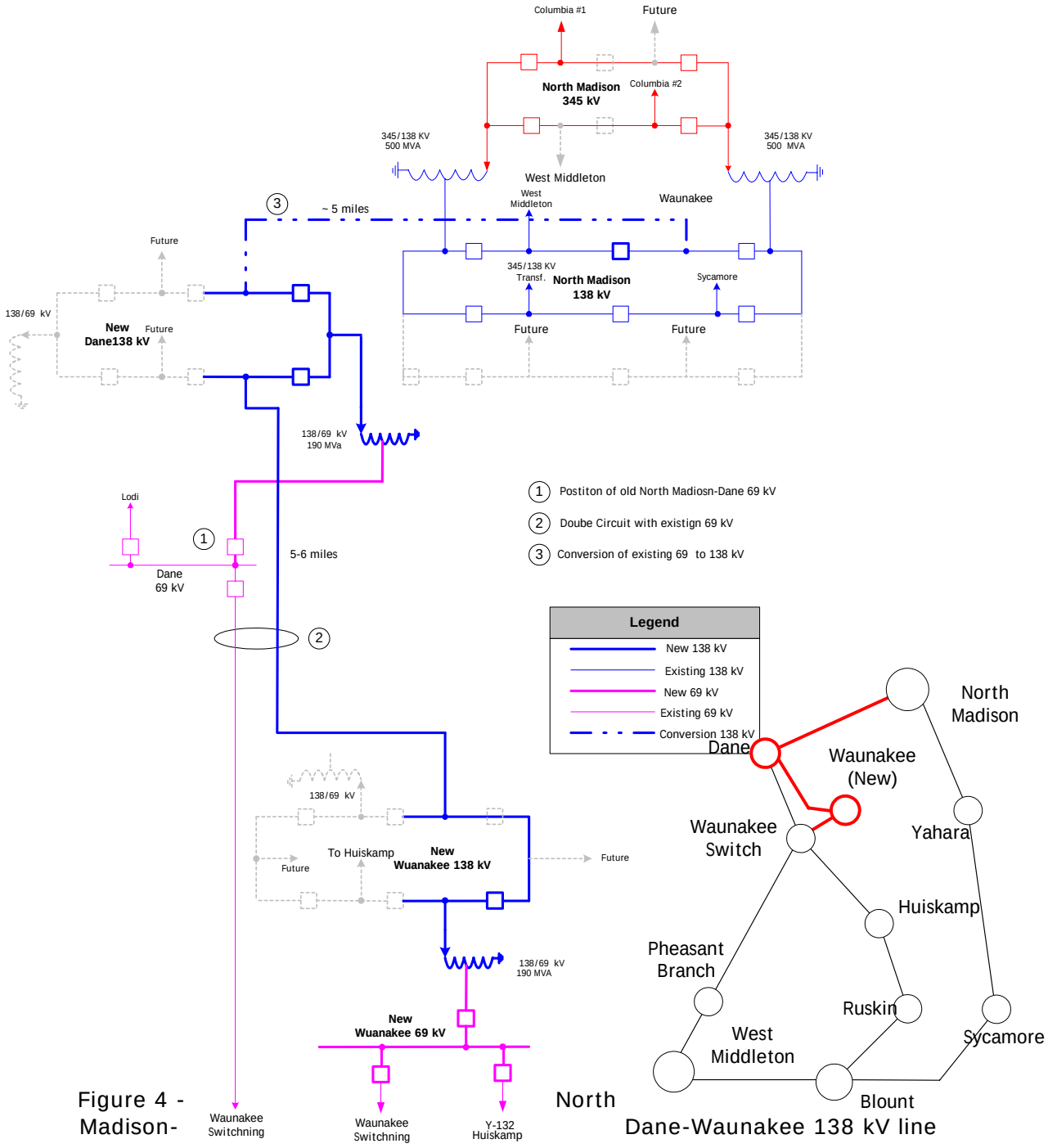


Figure 4 - North Madison-Dane-Waunakee 138 kV line

8.4 Alternative #4: Yahara River substation to Waunakee Substation 69 kV line

This alternative would be cheaper by about one million dollars (construction cost) but will perform poorly compared to the recommended project. The loading on Blount-Ruskin and North Madison-Dane 69 kV lines will be reduced to 92% and 98% respectively in 2009 but overloads will re-emerge in the following years (Table 5). When effective cost (construction minus loss savings, Section 9: Table 12) is taken into account the cost of this project will be much higher than the recommended project.

The conceptual one-line of this alternative is shown in Figure 5 below. It consists of the following:

i. Build a 69 kV bus at Yahara Substation
ii. Install a 138 / 69 kV transformer at Yahara River
iii. Construct a 6 mile long overhead 69 kV line from Yahara to Waunakee on new right of way
iv. Add a 69 kV breaker at Waunakee Switching Substation.

The preliminary cost estimate for the alternative 4 is 10 million dollars.

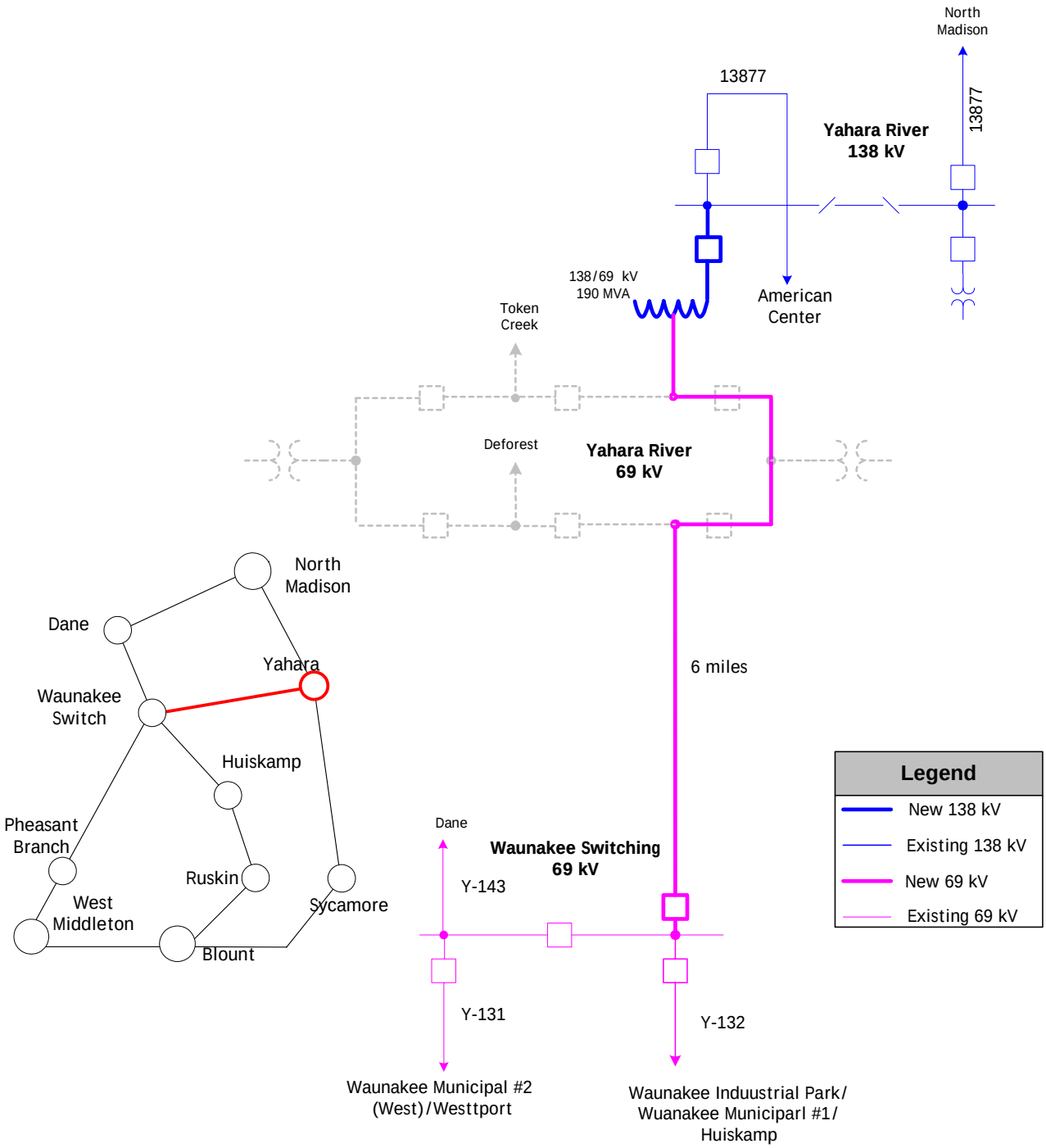


Figure 5 - Yahara River to Waunakee 69 kV line

8.5 Alternative #5: Sycamore-Ruskin 69 kV line

This 69 kV line alternative was not deemed to be a viable solution for the following reasons:

1. It will not eliminate overloads on North Madison-Dane line (Section 9: Table 3)
2. The overloads on Blount-Ruskin line will re-emerge in 2012 and North Madison-Dane line 69 kV overloads will get worse (Table 5)
3. There are no loss savings
4. The initial construction cost will be lower by three million dollars but effective cost when loss savings are taken into account will be much higher (Section 9: Table 12)

The conceptual one-line of this alternative is shown in Figure 6 below. It consists of the following:

i. Construct a 2.5 mile long 69 kV underground line between Sycamore and Ruskin substations
ii. Add a 69 kV breaker at Sycamore Substation.
iii. Add a 69 kV breaker at Ruskin Substation.

The preliminary estimate for the above work is about 7.5 million dollars.

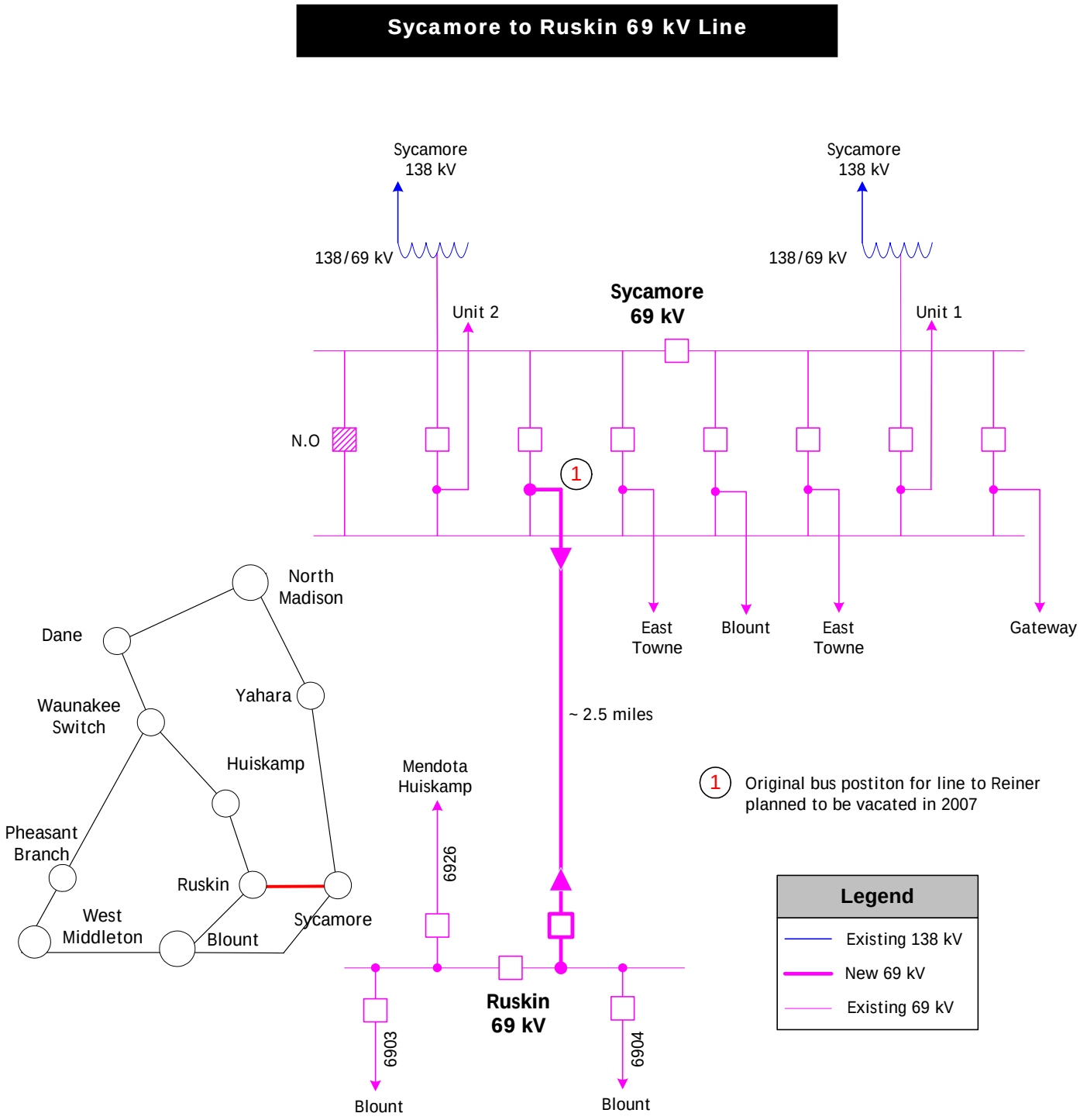


Figure 6 – Sycamore to Ruskin 69 kV underground circuit

9. Analyses

Analyses were conducted using 2009, 2010, 2012 and 2014 models, which were built in 2004, 2005, 2003 and 2005 respectively. One-line diagrams for the recommended project and alternatives are provided Figure 1, Figure 3, Figure 4, Figure 5 and Figure 6.

9.1 Thermal Analysis

Various combinations of power plant dispatch can be used to meet specific load demands. Power plants are typically dispatched according to their production cost and availability. Because the location of the power plants will affect how power flows on the transmission network, it is necessary to run power flows model with different generation scenarios to determine performance of the transmission network under system intact and single contingency conditions. The year 2009 scenarios depicting peak loads and two generation scenarios within Dane County are provided in Appendix D and Appendix F.

9.1.1 Base System (no reinforcements)

In 2009 single contingences were found to produce thermal overloads on the Blount-Ruskin and North Madison-Dane 69 kV lines. Severe overloads were observed on the North Madison-Dane 69 kV line if subsequent to the loss of first circuit the second Blount-Ruskin line is taken out of service or tripped due to heavy loading.

The severity and number of overloads will increase with time without the recommended project. The results of are as follows (Table 2a and Table 2b):

Table 2a – Intact System (Dane County Generation ~ 780 MW)

Year	Circuit Overloaded	% Loading
2009	North Madison-Dane	90
2010	North Madison-Dane	93
2014	North Madison-Dane	113

Table 2b - Single Contingency (Dane County Generation ~ 780 MW)

Year	Circuit Overloaded	% Loading	Contingency
2009	Blount – Ruskin 1	118%	Blount – Ruskin 2
2009	Blount – Ruskin 2	118%	Blount – Ruskin 1
2009	North Madison-Dane	102%	West Middleton-Pheasant Branch
2009	North Madison-Dane	99%	North Madison-ABS
2009	North Madison-Dane	97%	North Madison-West Middleton
2010	Blount – Ruskin 1	119%	Blount – Ruskin 2
2010	Blount – Ruskin 2	119%	Blount – Ruskin 1
2010	Blount – Ruskin 1	100%	North Madison-Dane
2010	Blount – Ruskin 2	100%	North Madison-Dane
2010	North Madison-Dane	102%	West Middleton-Pheasant Branch
2010	North Madison-Dane	105%	North Madison-ABS
2010	North Madison-Dane	101%	North Madison-West Middleton
2014	Blount – Ruskin 1	122%	Blount – Ruskin 2
2014	Blount – Ruskin 2	122%	Blount – Ruskin 1
2014	Blount – Ruskin 1	108%	North Madison-Dane
2014	Blount – Ruskin 2	108%	North Madison-Dane
2014	North Madison-Dane	128%	West Middleton-Pheasant Branch
2014	North Madison-Dane	118%	North Madison-ABS
2014	North Madison-Dane	130%	North Madison-West Middleton
2014	North Madison-Dane	106%	Christiana-Kegonsa
2014	North Madison 138/69 kV Transformer	104%	North Madison-ABS
2014	North Madison-ABS	107%	North Madison 138/69 kV Transformer
2014	North Madison-ABS	112%	Kegonsa-McFarland
2014	North Madison-ABS	104%	North Madison-West Middleton
2014	North Madison-ABS	99%	Christiana-Kegonsa Circuit 1
2014	Christiana-Kegonsa Circuit 2	108%	Christiana-Kegonsa Circuit 1
2014	Christiana-Kegonsa Circuit 1	108%	Christiana-Kegonsa Circuit 2

9.1.2 Comparison of Alternatives

The values listed in Table 3, Table 4 and Table 5 are percent flows of allowable capability on a line or transformer for the worst contingency in the study area. These tables summarize the results of the thermal study for loss of a single transmission element both before and after the various alternatives studied. The loadings on critical lines in the study area are provided with overloads highlighted in red and bold color.

For the heavily loaded elements (Blount-Ruskin and North Madison-Dane 69 kV lines), the recommended project, Madison-Huiskamp 138 kV line, will provide the most relief compared to other alternatives but will increase flow on 69 kV outlets from Waunakee Switching substation to West Middleton and Blount. The preliminary assessment of these outlets indicates that the limitations are related to terminal equipments and could be fixed easily (additional details on these lines are provided in Appendix B: Table B1 and Table B2). Mitigation of these limits is already underway.

In 2012 thermal overloads on Blount-Ruskin and North Madison-Dane 69 kV lines would re-emerge under certain alternatives but not under North Madison-Huiskamp 138 kV line. These overloads re-emerge because these alternatives add capacity by voltage conversion of existing lines without installing a new source from North Madison into the area.

Table 3 – Thermal Analysis 2009 (model built in 2004)

					% of Summer Emergency Rating							
Dane County Generation MW →					780						870	
Contingency	Critical Elements	KV	Conductor Limit	SE Rating	10a-09-04	11a-09-04	16a-09-04	12a-09-04	13a-09-04	15a-09-04	20a-09-04	26a-09-04
			MVA	MVA	B	N-W	N-H[1]	Y-W	S-R	N-D-W	B	N-H[1]
NMA-ABS	WKS–Waunakee 1	69	177	72	61	105	49	58	61	103	57	
NMA 138/69 kV Tr.	WKS –Waunakee 1	69	177	72	11	69	95	38	9	79		
NMA-ABS	Waunakee1 – WKP	69	177	72	50	94	58	47	50	92	46	
NMA 138/69 kV Tr.	Waunakee1 – WKP	69	177	72	11	58	105	27	13	68		
NMA 138/69 kV Tr.	WKP - Huiskamp	69	177	72	21	44	116	13	24	55		
WMD-PHB	WKS- Waunakee 2	69	101	72	102	98	99	100	102	98	102	
NMA- WMD	WKS- Waunakee 2	69	101	72	41	105	90	79	58	104	55	
WMD- PHB	Waunakee #2-	69	101	72	95	97	91	93	94	96		
WMD- PHB	PHB-Westport	69	101	49	109	104	105	106	108	104	108	
NMA-WMD	PHB-Westport	69	101	49	43	114	93	76	44	113	40	
WKS - Waunakee 2	West Middleton-	69	83	72	100	100	100	100	100	100	100	
NMA 138/69 kV Tr.	West Middleton-	69	83	72	104	29	50	66	102	18		
NMA-Dane 138 kV (new)	West Middleton-	69	83	72	-	-	-	-	-	107		
Blount – Ruskin 2	Blount – Ruskin 1	69	50	50	**118**	68	40	92	76	68	**124**	49
Blount – Ruskin 1	Blount – Ruskin 2	69	50	50	**118**	68	40	92	76	68	**124**	49
WKS-Waunakee 1	Blount – Ruskin 1	69	50	50	92	92	13	92	66	92		
WKS-Waunakee 1	Blount – Ruskin 2	69	50	50	92	92	13	92	66	92		
WMD- PHB	Blount – Ruskin 1	69	50	50	86	40	27	60	66	40		
WMD- PHB	Blount – Ruskin 2	69	50	50	86	40	27	60	66	40		
NMA-Dane 138 kV (new)	Blount – Ruskin 1	69	50	50	88	-	26	-	-	92		
NMA-Dane 138 kV (new)	Blount – Ruskin 2	69	50	50	88	-	26	-	-	92		
WMD-PHB	North Madison-	69	84/96	96	**102**	40	54	70	**100**	-	**99**	54
NMA-ABS	North Madison-	69	84/96	96	**99**	44	54	**100**	97	-	94	53
NMA-WMD	North Madison-	69	84/96	96	97	44	55	74	94	-	93	54
NMA-ABS	NMA-Dane (new)	138	345/477	477	-	-	-	-	-	36		
WMD- PHB	Yahara-Waunakee	69	103/103	103	-	-	-	56	-	-		
NMA 138/69 kV Tr.	Sycamore-Ruskin	69	68/68	68	-	-	-	-	40	-		
NMA-ABS	NMA-Waunakee	138	345/477	477	-	27	-	-	-	-		
NMA 138/69 kV Tr.	NMA-Huiskamp	138	345/477	477	-	-	27	-	-	-		
NMA-ABS	Dane-Waunakee	138	345/477	477	-	-	-	-	-	21		
NMA-ABS	Dane Tr. (new)	138/69	345/477	187	-	-	-	-	-	39		
NMA-ABS	Waunakee Tr.	138/69	187/187	187	-	69	-	-	-	54		
WMD-PHB	Yahara Tr. (new)	138/69	187/187	187	-	-	-	31	-	-		
NMA 138/69 kV Tr.	Huiskamp Tr.	138/69	187/187	187	-	-	68	-	-	-		

[1] Recommended Project

WKS	Waunakee Switching Station	WKP	WKP – Waunakee Business Park
NMA	North Madison	PHB	PHB – Pheasant Branch
WMD	West Middleton		

B	Base Case without upgrades
N-W	North Madison Waunakee 138 kV line
N-H	North Madison-Huiskamp 138 kV line
Y-W	Yahara –Waunakee 69 kV line
S-R:	Sycamore-Ruskin 69 kV line
N-D-W	N-D-W: North Madison-Dane-Waunakee conversion existing 69 kV line to 138 kV
Blue Color	Thermal loading above terminal limits but below conductor's capability
Red Color	Thermal loading above circuit's load carrying capability

In Table 4 the results of thermal analysis on the 2010 model are provided. The reason for this analysis was to verify the need for the project with the latest system configuration and data. The year 2009 model was built in 2004 versus the 2010 model which was built in 2005. It is Planning's intention to verify the need of the project every year with the most updated data. As tabulated in Table 4 the overloads will get worse if the recommended project is not implemented.

Table 4 – Thermal Analysis 2010 (model built in 2005)

					% of Summer Emergency Rating			
Dane County Generation MW →					780		870	
Contingency	Critical Elements	KV	Conductor Limit	SE Rating	10a-10-05	16a-10-05	20a-10-05	26a-10-05
			MVA	MVA	B	N-H[1]	B	N-H[1]
WMD-PHB	WKS- Waunakee 2	69	101	72	107	103	106	103
NMA- WMD	WKS- Waunakee 2	69	101	72	60	85	53	78
WMD- PHB	Waunakee #2-Westport	69	101	72	97	93	96	93
WMD- PHB	PHB-Westport	69	101	49	120	116	119	115
NMA-WMD	PHB-Westport	69	101	49	50	75	42	68
NMA 138/69 kV Tr.	West Middleton-PHB	69	83	72	46	45	79	48
Blount – Ruskin 2	Blount – Ruskin 1	69	50	50	**119**	13	**130**	42
Blount – Ruskin kV 1	Blount – Ruskin 2	69	50	50	**119**	13	**130**	42
WKS-Waunakee 1	Blount – Ruskin 1	69	50	50	96	4	95	27
WKS-Waunakee 1	Blount – Ruskin 2	69	50	50	96	4	95	27
WMD- PHB	Blount – Ruskin 1	69	50	50	95	16	**99**	29
WMD- PHB	Blount – Ruskin 2	69	50	50	95	16	**99**	29
NMA 138/69 kV Tr.	Blount – Ruskin 1	69	50	50	**99**	14	**103**	25
NMA 138/69 kV Tr.	Blount – Ruskin 2	69	50	50	**99**	14	**103**	25
WMD-PHB	North Madison-Dane	69	84/96	96	**102**	60	97	58
NMA-ABS	North Madison-Dane	69	84/96	96	**105**	61	96	56
NMA-WMD	North Madison-Dane	69	84/96	96	**101**	61	92	57
NMA 138/69 kV Tr.	NMA-Huiskamp (new)	138	345/477	477	-	30	-	27
NMA 138/69 kV Tr.	Huiskamp Tr. (new)	138/69	187/187	187	-	76	-	70
[1] Recommended Project								

WKS	Waunakee Switching Station
NMA	NMA – North Madison
WMD	West Middleton
WKP	Waunakee Business Park
PHB	Pheasant Branch

B	Base Case without upgrades
N-H	North Madison-Huiskamp 138 kV line
Blue Color	Thermal loading above terminal limits but below conductor's capability
Red Color	Thermal loading above circuit's load carrying capability

The results in Table 5 are based on the model that was built in 2003 for year 2012. These results provide a measure of the long-term relative performance of the recommended project versus the alternatives. Table 5 shows that the recommended project performs much better than the alternatives.

Table 5 – Thermal Analysis 2012 (model built in 2003)

			MVA	MVA	% of Summer Emergency Ratings					
Dane County Generation →					833 MW					
Contingency	Critical Element	KV	Conductor Limit	SE Rating	40a-12-03	43a-12-03	42a-12-03	41a-12-03	46a-12-03	45a-12-03
					B	S-R	Y-W	N-W	N-H[1]	N-D-W[2]
NMA-ABS	WKS-Waunakee 1	69	146/177	72	57	57	84	120	108	119
NMA-ABS	Waunakee 1 - WKP	69	146/177	72	49	49	51	112	116	111
NMA-ABS	WKP - Huiskamp	69	146/177	72	44	45	39	108	120	107
NMA 138/69 kV Tr.	WKP - Huiskamp	69	146/177	72	41	45	5	50	108	69
North Madison-ABS	Huiskamp – Mendota	69	145/199	72	72	20	11	81	120	80
Yahara-American CTR	Huiskamp – Mendota	69	145/199	72	13	13	44	71	106	70
North Madison-ABS	Mendota-Ruskin	69	146/177	72	80	15	6	73	112	76
Yahara-American CTR	Mendota-Ruskin	69	146/177	72	12	11	36	63	98	62
WMD-PHB	Waunakee 2- WKS	69	101/101	72	96	96	95	110	93	110
WMD-PHB	Waunakee 2-Westport	69	101/101	72	83	83	82	97	81	97
WMD-PHB	PHB-Westport	69	101/101	49	94	94	93	116	91	116
WKS-Waunakee 2	WMD-Pheasant Branch	69	83/83	72	96	97	97	97	97	97
Blount – Ruskin Ovhd 2	Blount – Ruskin Ovhd 1	69	50/50	50	**145**	**100**	**109**	65	30	66
Blount – Ruskin Ovhd 1	Blount – Ruskin Ovhd 2	69	50/50	50	**145**	**100**	**109**	65	30	66
Waunakee 1-WKP	Blount – Ruskin Ovhd 1	69	50/50	50	55	70	89	90	75	89
Waunakee 1-WKP	Blount – Ruskin Ovhd 2	69	50/50	50	55	70	89	90	75	89
NMA-Dane(new)	Blount – Ruskin Ovhd 1	69	50/50	50	-	-	-	-	-	**109**
NMA-Dane(new)	Blount – Ruskin Ovhd 2	69	50/50	50	-	-	-	-	-	**109**
NMA-ABS	NMA Tr.	138/69	187/224	224	88	88	88	63	66	46
NMA-ABS	NMA-Dane	69	84/96	96	**103**	**103**	**104**	46	58	-
WMD-PHB	NMA-Dane	69	84/96	96	91	90	67	39	53	-
NMA-ABS	NMA-Dane (new)	138		477	-	-	-	-	-	40
NMA-ABS	Dane-Waunakee (new)	138		477	-	-	-	-	-	24
NMA 138/69 kV Tr.	NMA-Waunakee (new)	138		477	-	-	-	32	-	-
NMA-ABS	NMA-Huiskamp (new)	138		477	-	-	-	-	31	-
Yahara-American CTR	Yahara-Waunakee (new)	69		103	-	-	78	-	-	-
Sycamore-Blount	Sycamore-Ruskin (new)	69		68	-	64	-	-	-	-
NMA-ABS	Dane Transformer (New)	138/69		187	-	-	-	-	-	58
NMA-ABS	Waunakee Transformer (new)	138/69		187	-	-	-	82	-	61
Yahara-American CTR	Yahara Transformer (new)	138/69		187	-	-	43	-	-	-
NMA-ABS	Huiskamp Transformer (new)	138/69		187	-	-	-	-	80	-
NMA-Deforest	Reiner-Burke	69		69	**103**	**103**	**103**	**104**	**105**	**104**
Femrite 138/69 kV	Sycamore-Royster	69	81/81	81	**105**	**106**	**105**	**106**	**107**	**106**
Christiana-Kegonsa #2	Christiana-Kegonsa #1	138	479/479	479	94	94	93	90	90	90
Kegonsa-McFarland	North Madison-ABS	138	323/323	323	79	82	89	73	70	72

[1] Recommended Project
[2] Conversion between NMA-Dane, 69 kV and 138 kV lines double circuit between Dane and Waunakee

WKS	Waunakee Switching Station	WKP	Waunakee Business Park
NMA	NMA – North Madison	PHB	Pheasant Branch
WMD	West Middleton		

B	Base Case without upgrades
N-H	North Madison-Huiskamp 138 kV line
Blue Color	Thermal loading above terminal limits but below conductor's capability
Red Color	Thermal loading above circuit's load carrying capability

9.2 Voltage Analysis

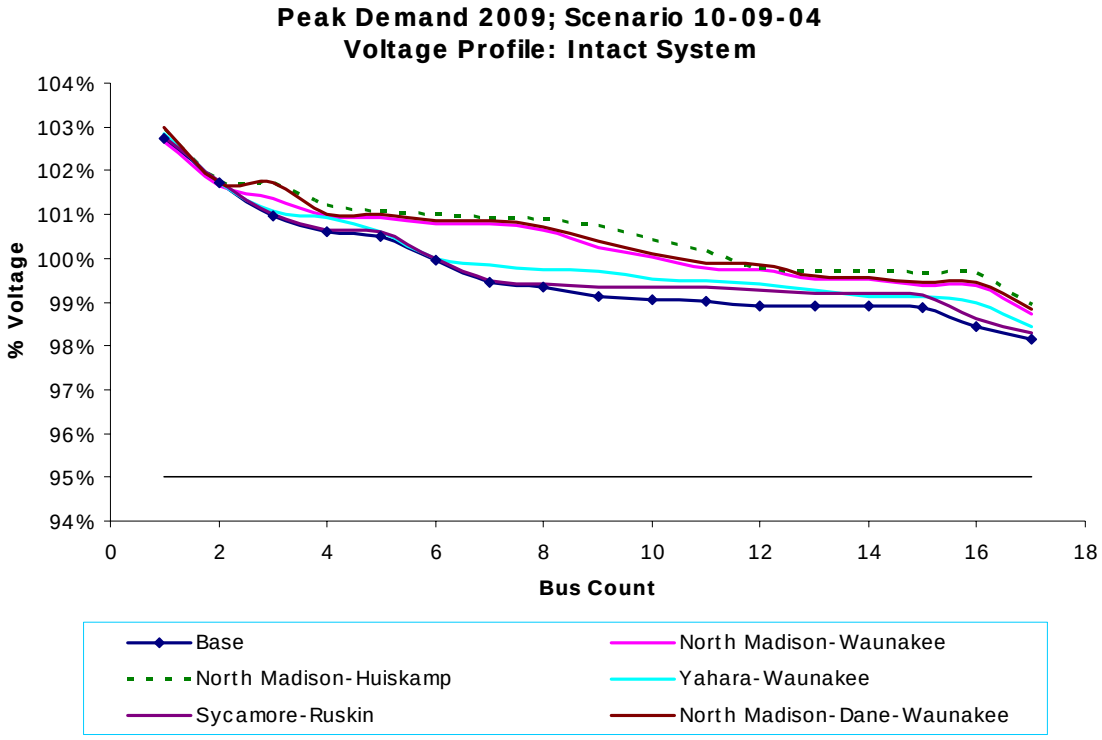
The voltage values listed in Table 6a and Table 6b are average voltages in the study area as a percentage of the nominal value under both normal intact system conditions and with one transmission element out of service (worst contingency). A total of 17 buses were selected for voltage monitoring in the study area and the results are summarized with a single quantity called “average voltages” to assist in comparisons of various alternatives. The average voltages give a composite picture across the study area and indicate how well the transmission system will maintain voltages for various alternatives. The corresponding reactive power being generated (MVAR output) by on-line generating units, once the contingency has been outaged and the transformer taps and shunt adjustments are made, is also provided as percentage to the total capability of on-line units. Voltages are projected to be well within planning limits in 2009 in the study area under 138 kV or 69 kV alternatives but in 2012 voltage are trending downwards where violations would occur under null or 69 kV alternatives before any additional operating steps are taken but will meet planning limits for alternatives involving 138 kV reinforcements including the recommended project. Figure 7 and Figure 8 are provided for comparison of study area voltage profile for various alternatives under intact system and worst contingency conditions in year 2009 and 2012. Elevated usage of available reactive power, above 95% after contingencies under all scenarios, is an indication that the system may be susceptible to voltage collapse especially for scenarios with reduction in dispatch of local generation. Additional voltage collapse analysis may identify the need for additional reinforcements.

Table 6a - Average Voltages (%) and Total MVAR Output (%) -Peak Demand 2009

	10a-09-04	13a-09-04	12a-09-04	11a-09-04	16a-09-04	15a-09-04
	B	S-R	Y-W	N-W	N-H*	N-D-W
Normal; Average Voltages	99.68	100	100	99.99	99.85	100
Normal: MVAR Output	47.54	46.02	44	46.73	46.59	45.00
Worst Contingency	NMA-ABS	NMA-ABS	Waunakee-Westport	WMD-Pheasant Branch	NMA-ABS	NMA-Dane
Contingency: Average Voltage	98.44	99.31	98.93	99.30	98.44	98.50
Contingency: MVAR Output	60.38	58.10	44.44	46.88	59.59	51.09
* Recommended Project						
NMA: North Madison, WMD: West Middleton						

Table 6b -Average Voltages (%) and Total MVAR Output (%) - Peak Demand 2012

	40a-12-03	43a-12-03	42a-12-03	41a-12-03	46a-12-03	45a-12-03
	B	S-R	Y-W	N-W	N-H*	N-D-W
Normal; Average Voltages	96.79	96.81	97.06	97.78	97.72	97.88
Normal: MVAR Output	93.43	93.02	93.05	90.77	90.15	90.45
Worst Contingency	NMA-ABS	NMA-ABS	NMA-ABS	NMA-ABS	NMA-ABS	NMA-ABS
Contingency: Average Voltage	92.50	92.72	92.58	95.42	95.57	95.37
Contingency: MVAR Output	98.58	98.42	98.44	96.92	96.41	96.43
* Recommended Project NMA: North Madison						



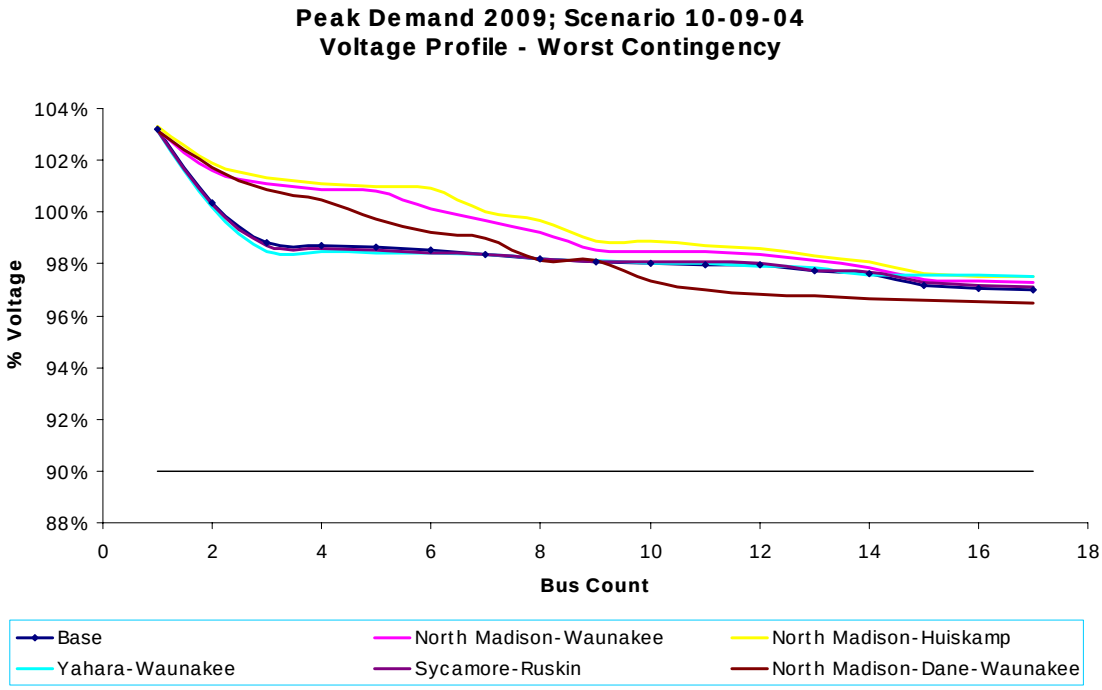
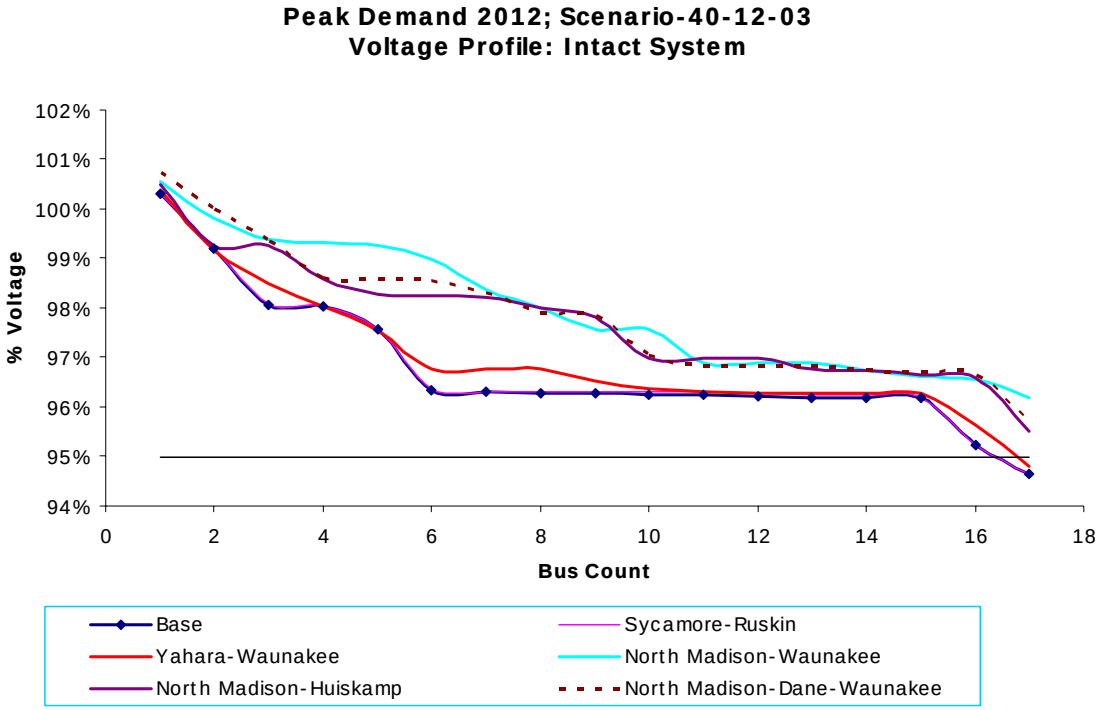


Figure 7 – Comparison of voltage profile in year 2009 for intact and worst contingency system conditions



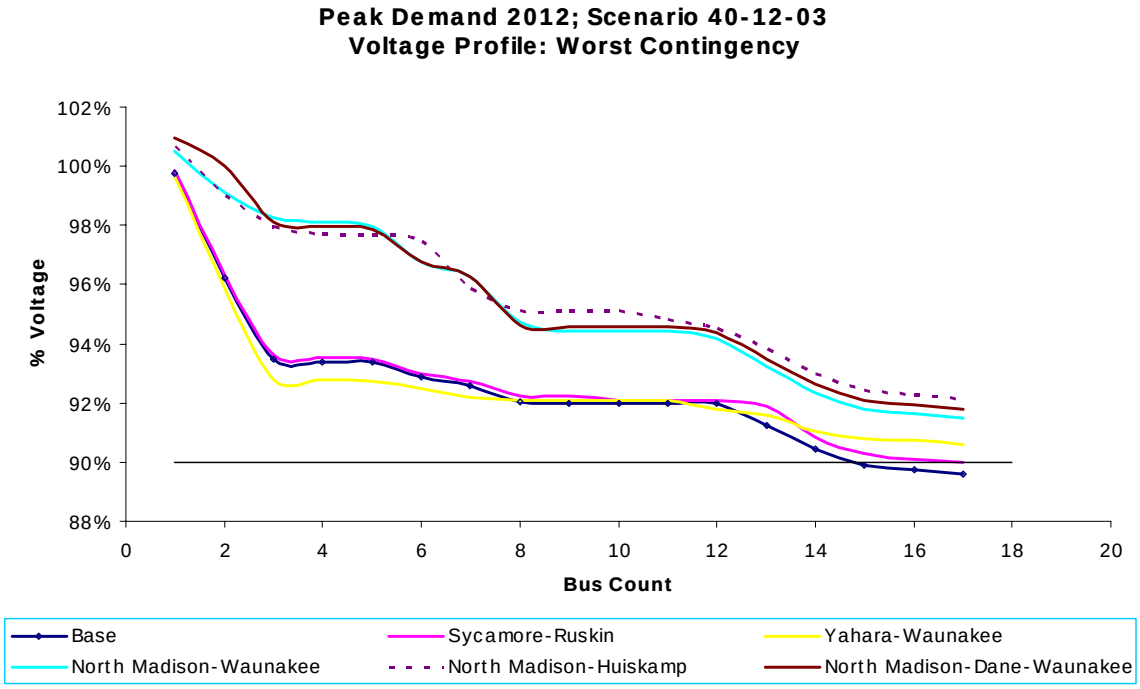


Figure 8 – Comparison of voltage profiles in year 2009 for intact and worst contingency system conditions

9.3 Steady State Voltage Stability Analysis

Calculation of average voltage and reactive output of local generators is immediately followed by steady state voltage stability analysis to determine how much additional load growth could be served under these initial conditions, until a point of voltage collapse for a single contingency is reached (Table 7a and Table 7b). This analysis provides an indication of the number of years to steady-state voltage collapse.

Considering results provided in Table 7a and Table 7b it is concluded that the recommended project would provide protection from voltage collapse due to single contingencies for a couple of years beyond 2012. It is probable that as 2014 approaches, local utilities will have additional contracts for imports and resulting levels of local generation could be considerably less than was assumed. This would likely require acceleration of next phase of transmission system reinforcements in the area in order to prevent voltage collapses. Alternatives with 138 kV upgrades would perform better than the alternatives involving only 69 kV upgrades.

Table 7a –Voltage Stability Limits and Growth - 2009

	10a-09-04	11a-09-04	16a-09-04	12a-09-04	13a-09-04	15a-09-04
	B	S-R	Y-W	N-W	N-H*	N-D-W
Voltage Stability Limit	1524	1555	1564	1524	1524	1559
Worst Contingency	N. Madison-ABS	N. Madison-ABS	N. Madison-ABS	N. Madison-ABS	N. Madison-ABS	N. Madison-ABS
Years Of Growth	3	4	4	3	3	4
Imports: 60% from 363, 20% from 364, 20% from WEC Base Load: 1316 MW * Recommended Project						

Table 7b Voltage Stability Limits and Growth - 2012

	40a-12-03	43a-12-03	42a-12-03	41a-12-03	46a-12-03	45a-12-03
	B	S-R	Y-W	N-W	N-H*	N-D-W
Voltage Stability Limit	1541	1541	1541	1596	1606	1596
Worst Contingency	N. Madison-ABS	N. Madison-ABS	N. Madison-ABS	N. Madison-ABS	N. Madison-ABS	N. Madison-ABS
Years Of Growth	1	1	1	2	2	2
Imports: 60% from 363, 20% from 364, 20% from WEC Base Load: 1472 MW * Recommended Project						

9.4 System Loss Analysis

Power losses at the time of peak are a measure of the additional generating capacity that must operate in order to deliver the power demanded by customers at the point of use. Transmission losses occur not only at the time of system peak, but throughout the year.

A system loss analysis was conducted using 2009 summer peak power flow case. System loss comparison and projected savings on 20-year base for recommended project and alternatives are listed in Table 8. These saving include both loss reduction at peak (capacity benefit) and the rest of the year (energy cost). ATC system loss benefit over 20 years is estimated to be approximately 15.72 million in 2008 dollars with the implementation of the recommended project which is comparable to savings from Alternative #2 and Alternative #3.

Table 8 – Loss Savings

	Alternative #1 Base Case (Do nothing option)	Alternative #2 North Madison-Waunakee 138 kV Line	Alternative #3 North Madison-Dane Conversion from 69 to 138 kV Dane-Waunakee double circuit 138 kV	Alternative #4 Yahara River-Waunakee 69 kV Line	Alternative #5 Sycamore-Ruskin 69 kV Line	Recommended Project North Madison-Huiskamp 138 kV Line
Conductor		ACSR T2-Hawk 2-477 kcmil 26/7	ACSR T2-Hawk 2-477 kcmil 26/7	ACSR Hawk 477 kcmil 26/7	650 kcmil Cu HPFF Pipe Type Cable	ACSR T2-Hawk 2-477 kcmil 26/7
System Losses MW	352	349	349	351	352	349
Reduction MW	0	3	3	1	0	3
20 Year Value NPV in 2008 $M	0	15.72	15.72	5.25	0	15.72
Energy Saving per Year GWH	0	17.47	17.47	5.82	0	17.47

The cost of energy is obtained from Power Daily North America an industry publication which is then averaged for peak and shoulder peak months. From industry literature the current capacity cost is $600-$800/kW to build, ATC loss analysis is based on capacity cost of $600/kW.

9.5 Common Mode Failure Analysis

The common mode failure in this study refers to the loss of a single transmission structure that holds two transmission circuits. The Columbia-North Madison 345 kV

double circuit and the Christiana-Kegonsa 138 kV double circuit are each exposed to the risk of common mode failure.

Results of common mode failure analyses are provided in Table 9.5a and Table 9.5b and following conclusions are made:

- There is a greater risk of voltage collapse from common mode failures in the Dane County starting 2009 or earlier
- The recommended project will not mitigate this risk but neither will the alternatives
- Higher level of local generation dispatch (typically neither economic nor realistic) will have some impact but not enough
- Common mode failure of Columbia-North Madison 345 kV double circuit would be the worst case
- It is assumed that the divergence of power flow model is an indication of voltage collapse conditions
- Load shed during common mode conditions is a valid option to eliminate cascading but was not tested for this study

This project was not designed to address common mode failure. The recommended project and alternatives do not mitigate the threat of voltage collapse from common mode failures at the time of peak without shedding load. The amount of load shed required is not tested for this study. Additional 345 kV projects are being planned and studied to mitigate these common mode failure risk

Table 9.5a – Risk of Voltage Collapse (Dispatch Level: 780 MW)

Reinforcement Scenario →		Base (No upgrades)		North Madison-Huiskamp 138 kV Line	
Dane County Generation	Year	Common Mode Failure		Common Mode Failure	
780 MW		Columbia-North Madison	Christian-Kegonsa	Columbia-North Madison	Christian-Kegonsa
	2009	TRUE[1]	FALSE	TRUE	FALSE
	2010	TRUE	TRUE	TRUE	TRUE
[1]TRUE = Potential voltage collapse					

Table 9.5b - Risk of Voltage Collapse (Dispatch Level: 870 MW)

Reinforcement Scenario →		Base (No upgrades)		North Madison-Huiskamp 138 kV Line	
Dane County Generation	Year	Common Mode Failure		Common Mode Failure	
870 MW		Columbia-North Madison	Christian-Kegonsa	Columbia-North Madison	Christian-Kegonsa
	2009	FALSE[1]	FALSE	FALSE	FALSE
	2010	TRUE	FALSE	TRUE	FALSE
	2014	TRUE	TRUE	TRUE	TRUE
[1]TRUE Potential voltage collapse					

9.6 Data for Electromagnetic Filed (EMF) Calculations

Loadings (current flow) on the proposed line for summer peak and summer shoulder peak (approximately 70% of the peak load) conditions are provided in Table 10a for EMF calculations. This type of study assumes that the entire system is intact and that there are no forced or planned outages. It is projected that before 2014 a 138 kV line will be extended from Huiskamp substation to Blount substation which will result in increased flow on the proposed line. Therefore before and after flows are provided in Table 10a for 2014 for comparison. For 2018 it was assumed that load will continue to grow at a rate of about 4% on average for the entire Dane County and all 345 kV and 138 kV projects identified in the report from Dane County Energy Initiative will be completed.

Table 10a - Current Flow on North Madison-Huiskamp 138 kV Line

Year →	2008	2009	2010	2014		2018
Scenario →	16a-08-03	16a-09-04	16a-10-05	11b-14-05	12a-14-05[1]	12a-18-05[2]
Peak load	421A	412 A	462A	526A	783A	872A
80% of peak load	327A	340A	373A	418A	618A	698A

[1] After extension of proposed 138 kV line from Huiskamp to Blount

[2] After completion of Dane County Energy Initiative projects.

Table 10b - Current Flow on North Madison-Yahara 138 kV Line

Year	2008	2018
Scenario →	16a-08-04	12a-18-05
Peak Load	633A	1351A
80% of peak load	479A	1080A

Table 10c - Waunakee Industrial Park-Huiskamp 69 kV line

Year	2008	2018
Scenario →	16a-08-04	12a-18-05
Peak Load	323A	443A
80% of peak load	281A	354A

10. Siting/Routing Summary

The recommended North Madison-Huiskamp 138 kV transmission line will require more than one mile of new right-of-way and therefore will require a CPCN application. ATC in its application to the Public Service Commission in February, 2006 will propose Highway I and Highway 113 as preferred route for this line. North Madison and Huiskamp substation are located in the towns of Vienna and Westport respectively.

The alternate route follows Patton, Cuba Valley, Schumacher and Raemisch Roads to the existing transmission line just south of the Waunakee industrial park, which runs to the Huiskamp substation.

The preferred route has several significant advantages over the alternate route, including reduced impacts to local resources such as Schumacher Farm Park and the wetlands near Six Mile Creek. This route uses the east side of Hwy. 113, approximately 1,500 feet from the new school site and 1,000 feet from Savannah Village.

11. Other Considerations

In addition to the key drives discussed in the Need and Null Alternative sections, the following discussion details significant issues that require consideration in evaluation of the recommended project.

11.1 Transfer Capability

A First Contingency Import Transfer Capability (FCITC) was performed to determine the relative ability of each alternative to move power into Dane County (Table 11a and Table 11b). These MW transfer levels are based only on the limiting elements within Dane County ignoring outside limits that may dictate lower levels. The proposed project will perform relatively better than the alternatives. It should be noted that this assessment is based on thermal capability only and does not address voltage stability or dynamic stability issues. The values are calculated for reliability purposes and do not reflect commercial available transfer capability. Only elements with a 3 percent or greater distribution factor were reported.

Table 11a - First Contingency Incremental Import Capability; 2009

	10a-09-04	13a-09-04	12a-09-04	11a-09-04	16a-09-04	15a-09-04
	B	S-R	Y-W	N-W	N-H[1]	N-D-W
MW	0	518	555	0	0	371
1st Violation	North Madison-Dane	North Madison-ABS	North Madison-ABS	North Madison-Dane	North Madison-Dane	Dane-Waunakee 69 kV line
Contingency	North Madison-ABS	Kegonsa-McFarland	Kegonsa-McFarland	North Madison-ABS	North Madison-ABS	Dane-Waunakee 138 kV line

Excluding external and Waunakee Switching to West Middleton and Waunakee Switching to Blount terminal limitations
Sources: CE, WEC, and Alliant
Sink: Dane County
[1] Recommended Project

Table 1bb - First Contingency Incremental Import Capability; 2012

	40a-12-03	43a-12-03	42a-12-03	41a-12-03	46a-12-03	45a-12-03
	B	S-R	Y-W	N-W	N-H[1]	N-D-W
MW	0	0	29	414	409	423
1st Violation	North Madison-Dane	North Madison-Dane	North Madison-ABS	North Madison-ABS	Huiskamp 138/69 kV Tr.	North Madison-ABS
Contingency	North Madison-ABS	North Madison-ABS	Kegonsa-McFarland	Kegonsa-McFarland	North Madison-ABS	Kegonsa-McFarland

Excluding limitations
External to Dane County
Waunakee Switching to West Middleton and Waunakee Switching to Blount terminal limitations
Contingencies East of Rockdale (Boxelde-Rockdale, Jefferson-Rockdale); Stony Brook to Jefferson upgrade not in the model
Femrite Auto Transformer
Sources: CE, WEC, and Alliant
Sink: Dane County
[1] Recommended Project

11.2 Maintenance and Construction Outages

As indicated in Figure 2 there are three sources for supplying power into the study area. The alternatives that do not add a new source in the study area do not adequately facilitate routine maintenance outages. If any of these three sources is taken out of service for maintenance, the transmission system must be able to sustain loss of another element during that time.

The Blount-Ruskin lines are presently the weakest link each having only 50 MVA load carrying capability. The load in the study area is projected to be 204 MW during the 2009 daily peaks, including flow to Lodi. A maintenance outage with the North Madison-Dane 69 kV line out of service along with the simultaneous forced outage of one the Blount-Ruskin 69 kV lines is the worst-case scenario. Area loads would have to be substantially lower than projected to perform any maintenance. Thus the ability to do maintenance is severely limited to extreme low loading periods which will become more and more scarce as load continues to grow. Thus any alternative that requires rebuilding of the existing 69 kV circuits between North Madison-Dane and Dane-Waunakee, must allow for this circuit to be kept energized most of the time during construction.

In negotiation with the City of Madison, ATC agreed to place the portion of the Blount-Ruskin double circuit 69 kV lines from Blount to East Johnson Street underground in about the 2010 time frame (Appendix A). Placing this circuit underground introduces another consideration for planning and operation of the transmission network in the study area. Underground cables are very reliable and seldom fail, but when they do fail, the location and repair of the failure takes much longer than an overhead line (typically several weeks). Because of this along with the fact that Dane County relies heavily on imports to meet its needs, a new import source into the area is essential for maintaining power system reliability in the area. The recommended project provides the fourth import source.

11.3 Conductor and Transformer Selection

Line conductor: From Table 3 and Table 5, the highest loading on a new North Madison-Huiskamp 138 kV line during the 2009 to 2012 time frame, is projected to be 225 MVA. Savings from loss reductions are based on the impedance of T2 HAWK 477 kcmil 26/7 ACSR conductor. It was assumed that this conductor would provide a SN/SE capability of 345/477 MVA. There is no planning model to predict loading on this line during its useful life cycle but this line will be installed in a high growth area and loading will mostly likely increase throughout its life cycle. Planning therefore recommends T2 HAWK 477 kcmil 26/7 ACSR for this circuit.

138/69 kV Transformer: Initial flow on the proposed Huiskamp 138/69 kV transformer, under contingency conditions, would be 127 MVA in 2009 and would increase to 150 MVA in 2012 before the extension of 138 kV from Huiskamp to Blount. The loading on the Huiskamp transformer would go down to 118 MVA after that but would continue to increase over time. Since this loading is above the standard 100 MVA transformer typically used in ATC, Planning recommends the installation of 138/69 kV transformer with a top summer emergency rating of 187 MVA. Since the voltage support in the area is a key consideration a ULTC (under load tap changer) should be included on this transformer.

11.4 Economic Analysis

Economic analysis for the five options evaluated indicates that the North Madison-Huiskamp 138 kV circuit is by far the most economical of the five based on the planning level cost estimates.

Table 12 – Effective Cost (2008 dollars)

Alternative		Estimated Project Cost $M	Estimated PV of Loss Cost Savings $M	Total of Cost minus Savings $M
1	**North Madison-Huiskamp 138 kV**	**10.44**	**15.72**	**(-5.28)**
2	North Madison-Waunakee	14.00	15.72	(-1.72)
3	North Madison-Dane-Waunakee	19.00	15.72	3.28
4	Yahara-Waunakee	10.00	5.25	4.75
5	Sycamore-Ruskin	7.50	0	7.50

11.5 Future Considerations

The 2005 series power flow model for year 2014 was used to verify the long-term performance of the project. This analysis shows that with the transmission system intact an overload on North Madison-Dane 69 kV line would likely occur if the recommended project is not completed (Table 13b). The results show that several inlets (transmission lines) from major import sources will be overloaded without the recommended project (Table 13c). Two of three lines from North Madison and both lines from Christiana will be above their load carrying capabilities. The only way to relieve these overloads is to run all the generation (except diesel units) in Dane County (870 MW). This level of generation dispatch is not economic and realistic. Even so it will not eliminate all the overloads and may actually make matters worse on some system elements.

Results clearly show that two major 345 kV sources into the area require additional outlets as Dane County load continues to grow. The most cost-effective way to accomplish this is to add another 138 kV outlet from North Madison to Huiskamp which will more evenly distribute power flow into Dane County from North Madison and will offload the Blount-Ruskin 69 kV lines.

Planning evaluated and concluded that an upgrade on the Blount-Ruskin 69 kV lines was not viable for several reasons:

1. The Blount-Ruskin proposal (Appendix A) will require a portion of the overhead right-of-way between Blount and Ruskin to be replaced with underground cable
2. There was room only for a one underground circuit in the duct bank.
3. Due to in proximity to other circuits this single circuit will not provide enough capacity to be equivalent to two overheads lines.
4. It would be very difficult to take outages to perform the needed work.

Despite these reservations let us assume;

> Scenario #1: The single underground section will be able to provide ratings equal to two overhead circuits or more.
>
> Scenario #2: The re-routing of Blount-Sycamore 138 kV cable pipe to Blount-Ruskin. This will parallel the cable section in scenario #1 to replace the two overhead lines with two underground cables.

In Table 13b and Table 13c results are provided for both scenarios and it is concluded that these scenarios are not viable alternatives; they don't eliminate overloads on outlets from North Madison under system intact and contingency conditions.

It is concluded from results in Table 13 that the recommended project will significantly reduce projected overloads. To achieve additional loading relief on the critical lines and transformers especially from North Madison, the extension of a new 138 kV line from North Madison to Huiskamp (phase 1) and ultimately to Blount (phase 2) will likely be required.

The impact of phase 2 (Huiskamp-Blount 138 kV upgrade) is also provided for comparison and reference. **The recommend project is the preferred option for addressing both the short and the long-term power delivery system needs in Dane County.**

Table 13a - 2014 Thermal Study Index

Scenario	345 kV upgrades	North Madison to Huiskamp 138 kV line	Huiskamp to Blount 138 kV line with 2nd Auto	Blount to Ruskin two 69 kV overhead lines	Blount to Ruskin one 69 kV Cable	Blount to Ruskin two 69 kV Cables
X0a-14-05	-	-	-	Yes	-	-
X0b-14-05	-	-	-	-	Yes	-
X0c-14-05	-	-	-	-	-	Yes
X1a-14-05	-	Yes	-	Yes	-	-
X1b-14-05		Yes	-	-	Yes	-
X1c-14-05	-	Yes	-	-	-	Yes
X2a-14-05	-	Yes	Yes	-	Yes	

Table 13b - Thermal Analysis 2014 (model built in 2005)
Intact System

	MVA	MVA	% of Summer Normal Ratings														
Dane County Generation Scenario (MW) →			**780**							**870**							
			Reinforcement Scenarios							Reinforcement Scenarios							
Critical Element	Conductor Limit	SN Rating	10a-14-05	10b-14-05-	10c-14-05	11a[1]-14-05	11b-14-05	11c-14-05	12a-14-05	20a-14-05	20b-14-05	20c-14-05	21a[1]-14-05	21b-14-05	21c-14-05	22a-14-05
North Madison-Dane	84	84	**113**	**111**	**110**	74	74	74	70	**108**	**105**	**105**	71	71	71	68

[1] Recommended Project
Red Color: Thermal loading above circuit's load carrying capability

Table 13c - Thermal Analysis 2014 (model built in 2005)
Single Contingencies

		MVA	MVA	% of Summer Emergency Ratings													
Dane County Generation Scenario (MW)→				780							870						
				Reinforcement Scenarios							Reinforcement Scenarios						
Contingency	Critical Element	Conductor Limit SN/SE	SE Rating	10a-14-05	10b-14-05	10c-14-05	11a[1]-14-05	11b-14-05	11c-14-05	12a-14-05	20a-14-05	20b-14-05	20c-14-05	21a[1]-14-05	21b-14-05-	21c-14-05	22a-14-05
Blount-Ruskin Ovhd #1	Blount-Ruskin Ovhd #2	50/50	50	122	-	-	9	-	-	-	129	-	-	14	-	-	-
Blount-Ruskin Ovhd #2	Blount-Ruskin Ovhd #1	50/50	50	122	-	-	9	-	-	-	129	-	-	14	-	-	-
NMA 138/69 Tr.	Blount-Ruskin Cable	100/100[2]	100	-	96	48	-	8	6	9	-	99	50	-	15	8	17
Huiskamp 138/69 kV Tr.	NMA-Dane	84/96	96	-	-	-	99	97	97	66	-	-	-	95	92	92	64
WMD-PHB	NMA-Dane	84/96	96	128													
NMA-ABS	NMA-Dane	84/96	96	118	117	117	69	69	69	67	112	110	110	66	66	66	65
NMA-WMD	NMA-Dane	84/96	96	130													
Blount-Ruskin cable	NMA-Dane	84/96	96	-	131	97	-	64	-	-	-	128	92	-	63	-	-
NMA-ABS	NMA 138/69 Tr.	187/224	224	104	103	103	78	78	78	66	98	98	98	75	75	75	64
NMA 138/69 Tr.	NMA-ABS	323/323	323	107	106	106	86	86	86	74	99	101	99	82	82	82	70
NMA-Huiskamp	NMA-ABS	323/323	323	-	-	-	87	87	85	89	-	-	-	81	81	81	83
Kegonsa-McFarland	NMA-ABS	323/323	323	112	112	112	99	98	98	77	103	102	104	89	89	91	74
NMA-WMD	NMA-ABS	323/323	323	104													
Christiana-Kegonsa #2	NMA-ABS	323/323	323	99													
Christiana- Kegonsa #2	Christiana-Kegonsa #1	479/479	479	108	108	108	103	103	103	100	99	99	99	96	95	96	93
Christiana- Kegonsa #1	Christiana-Kegonsa #2	479/479	479	108	108	108	103	103	103	100	99	99	99	96	95	96	93
Femrite 138/9 kV Tr.	Sycamore-Royster	81/81	81	107	107	107	108	108	108	110	97	97	97	99	98	99	100

[1] Recommended Project
[2] Ratings will depend on cable size and installation
Red Color: Thermal loading above circuit's load carrying capability
Blue Color: Thermal loading close to circuit's load carrying capability

12. Conclusion

The North Madison-Huiskamp line would provide significant loading relief to transmission facilities in and around the Madison metro area.

The North Madison-Huiskamp line would significantly improve reliability of service in Dane County by increasing the voltage stability limit for power transfer between Dane County and the surrounding area.

The capital cost for the North Madison-Huiskamp 138 kV is projected to be substantially less that of the other alternatives that perform somewhat comparably.

The North Madison-Huiskamp line results in a significant amount of system loss cost savings.

The North Madison-Huiskamp line would require the least amount of transmission line outages during construction when compared with alternatives evaluated.

13. Recommendation

ATC Planning recommends the construction of new North Madison-Huiskamp 138 kV line.

APPENDIX A - Proposal from ATC to the city of Madison

AMERICAN TRANSMISSION COMPANY LLC
THE ENERGY ACCESS COMPANY

Corporate Headquarters • P.O. BOX 47 • WAUKESHA, WI 53187-0047
262-506-6700 • Toll Free: 866-899-3204 • Fax: 262-506-6710 • www.atcllc.com

☑ Madison Fen Oak Office: 2 Fen Oak Court, Madison, WI 53718-8610, Phone 608-877-3600, Fax 608-877-3602

PROPOSAL
BLOUNT to RUSKIN

American Transmission Company's (ATC) proposal to the City of Madison for the electric transmission line known as Blount to Ruskin described as: Starting at Blount Substation; then east along the south side of East Main Street to the railroad corridor; then northerly along the easterly side of railroad corridor past E. Washington & East Johnson to Ruskin Substation at Commercial Avenue; then continuing northerly along east side of tracks from Commercial Avenue to Aberg Avenue across Oscar Mayer property and there ending. This proposal describes the improvement of the existing lines, placement of new pipe for electric transmission in First Street from East Main to north of Johnson Street, and the removal of the double circuit electric transmission lines along East Main Street.

An overview of certain segments of the Line provides that:

- The segment from Blount Substation to the first transmission pole north of Johnson Street will not change.
- The segment from Johnson Street north to Ruskin Substation (Commercial Ave) will replace existing lattice towers with new poles and wires.
- The segment from Commercial Avenue to Aberg Avenue (through Oscar Meyer) will replace existing lattice towers one for one with new poles. The current 6-wire configuration will be changed to a 3-wire design. A new metal pole will replace an existing wood pole where this line meets Aberg Avenue.
- The above-described work will start in the fall of 2003 and be completed by the end of 2004.

In addition, ATC will bury a new pipe for electric transmission line needs in First Street from East Main Street to north of Johnson Street in conjunction with Segment 2 (Thornton Ave to Second Street) of the East Washington Avenue Rebuild Project. That project is currently scheduled for 2006. There is also an existing spare pipe from Blount Substation to just short of the intersection of East Main and First Street. The connection to the newly installed pipe will offer an underground route from Blount Substation to Johnson Street.

Finally, ATC will remove a portion of the existing Blount to Ruskin overhead double circuit 69kV electric transmission line.

- The portion that shall be removed is the Blount Substation to Johnson Street segment and described as: Starting at Blount Substation, then along the south side of East Main Street to the east side of the railroad tracks, continuing northerly to a point north of Johnson Street and there ending.
- The time frame for removal shall be 2009/2010.

Signed this 24 day of Sept, 2003 on behalf of American Transmission Company LLC

Mark C. Williamson

V.P. Major Projects, American Transmission Company

Rev. 9.23.03

APPENDIX B – Terminal Upgrades

Table B1 - Waunakee Switching to West Middleton Terminal Upgrades

Line	Form	To	Line Sections	PSSE Model SN/SE	1st Limit SN/SE	2nd Limit SN/SE	3rd Limit SN/SE	Required SE MVA		Action
								2009	2012	
Y131	Waunakee Switching (38162)	Waunakee #2 (West) Tap (39816)	1-3/0 AWG ACSR T2 6/1 T2 Pigeon 101/101 MVA	72/72 MVA	Line Segment 101/101 MVA	NA	NA	> 78	>83	None Update PSSE Models
	Waunakee #2 (West) Tap (39816)	Westport (38675)	1-3/0 AWG ACSR T2 6/1 T2 Pigeon 101/101 MVA	72/72 MVA	Switch at Westport terminal 72/72 MVA	Line Segment 101/101 MVA	Na	> 73	>73	Eliminate 1st limit
	Westport (38675)	Pheasant Branch (38673)	1-3/0 AWG ACSR T2 6/1 T2 Pigeon 101/101 MVA	49/49 MVA	Conductor: 3/0 AWG Pigeon at Pheasant Branch terminal 49/54 MVA	Switch at Westport terminal 72/72 MVA	Line Segment 101/101 MVA	> 59	>60	Eliminate 1st limit
6963	Pheasant Branch (38673)	West Middleton (38668)	35-Pheasant Branch (2.57 miles): 1-336.4 Kcmil ACSR 18/1 Merlin 83/83 MVA West Middleton-West Middleton Riser (.04miles): 1500 Kcmil cable 99/99 MVA	72/72 MVA	Forward and Reverse Relay at West Middleton 72/72 MVA	Line Segment #1 83/83 MVA	Line Segment #2 and terminal conductor at pheasant Branch 99/93 MVA	> 72	>72	Eliminate 1st limit
Note: Some of the terminal upgrades may already be in the process. Ignore if the minimum rating requirements are achieved.										

Table B2 - Waunakee Switching to Huiskamp Terminal Upgrades

Line	From	To	Line Segments	PSSE Model SN/SE	1st Limit SN/SE	2nd Limit SN/SE	3rd Limit SN/SE	Required SE (MVA)		Comments
								2009	2012	
Y132	Waunakee Switching (38162)	Waunakee #1 and Industrial Park Tap (38163)	1-795 kcmil ACSR 26/7 Drake (0.71 miles) 146/177 MVA	72/72 MVA	1-4/0 AWG Cu 7 at Waunakee Switching Terminal 64/86 MVA Switch #6928B, 1200 A at Waunakee Switching Terminal 64/71 MVA	Forward and Reverse Relay at Waunakee Switching Terminal 72/72 MVA	Switch #381-A, 600 A at Tap 83/95 MVA 1-4/0 AWG Cu 7 at Waunakee Switching Terminal 64/86 MVA	> 76	>78	Eliminate 1st, 2nd and 3rd limit
	Waunakee #1 and Industrial Park Tap (38163)	Waunakee Industrial Park (38166)	1-795 kcmil ACSR 26/7 Drake (0.32 miles) 146/177 MVA	72/72 MVA * 119/119 MVA	Switch #384-A, 600 A at Tap 83/95 MVA Switch #1744-LB, 600 A at Tap 83/95 MVA	Line Segment 146/177 MVA 1-795 kcmil ACSR 26/7 Drake at Waunakee industrial Park terminal 146/166 MVA	Line Segment 146/177 MVA	> 76	>84	Eliminate 1st limit
	Waunakee Industrial Park (38166)	Huiskamp (38669)	1-795 kcmil ACSR 26/7 Drake (2.38 miles) 146/177 MVA	72/72 MVA	Switch #1746-LB at Waunakee Industrial Park Terminal 83/95 MVA	CT's at Huiskamp Terminal 143/143 MVA	Line Segment and terminal equipment at Huiskamp 146/158 MVA	> 84	>86	Eliminate 1st limit
Y-9	Huiskamp (38669)	Mendota (39165)	1-795 kcmil ACSR 26/7 Drake (4.16) miles) 145/199 MVA	72/72 MVA	Switches at Huiskamp terminal 72/72 MVA	CT at Huiskamp terminal 101/101 MVA	Breaker and CT at Huiskamp 143/143 MVA	> 49	>86	Eliminate 1st limit
Y-6926	Mendota	Ruskin	1 - 795.0 kcmil ACSR 26/7 Drake .06 miles	72/72 MVA	Line Segment 146/177 MVA			>45	>81	Update ratings
Note: Some of the terminal upgrades may already be in the process. Ignore if the minimum rating requirements are achieved.										

APPENDIX C – Dane County Coincident Peak Demand Summer 2006 (model built in 2005)

Table C1 - Madison Gas and Eclectic (MGE)

BUS#	NAME	SUBSTATION NAME	BSKV	ST	MW	MVAR	AREA	ZONE	OWNER
33590	BLK 14	BLACKHAWK 13.8 KV	13.8	1	29.3	5.5	367	367	383
33591	BLD14-1	BLOUNT 14 KV RADIAL	13.8	1	14	5.7	367	367	383
33592	BLD14-2	BLOUNT 14 KV RADIAL	13.8	1	9.6	2.1	367	367	383
33595	CSP 14	CROSS PLAINS 12.5 KV	12.5	1	10.6	2	367	367	383
33596	ECA14-1	EAST CAMPUS 14 KV BUS 1	13.8	1	25	12.7	367	367	383
33597	ECA14-2	EAST CAMPUS 14 KV BUS 2	13.8	1	36.1	12.7	367	367	383
33598	ETN14-1	EAST TOWNE 14 KV BUS 1	13.8	1	18.9	7.3	367	367	383
33599	ETN14-2	EAST TOWNE 14 KV BUS 2	13.8	1	12.3	3.7	367	367	383
33600	FEM14-3	FEMRITE 14 KV BUS 3	13.8	1	8.6	3.4	367	367	383
33601	FEM14-4	FEMRITE 14 KV BUS 4	13.8	1	8.3	1.5	367	367	383
33604	GWY 14	GATEWAY 14 KV	13.8	1	4.6	0.9	367	367	383
33606	HKP 14-2	HUISKAMP	13.8	1	13.8	2.5	367	367	383
33608	NSP 14-2	NINE SPRINGS 14 KV BUS 2	13.8	1	24.2	10.1	367	367	383
33609	PFL14-1	PFLAUM 14 KV BUS 1	13.8	1	17.3	3.1	367	367	383
33610	PHB 14	PHEASANT BRANCN 14 KV	13.8	1	29.6	9.7	367	367	383
33611	PHB 14-2	PHEASANT BRANCH	13.8	1	17	5.6	367	367	383
33612	RYS 14	ROYSTER 14 KV	13.8	1	16.2	4.8	367	367	383
33613	RKN14-1	RUSKIN 14 KV BUS 1	13.8	1	20	7.8	367	367	383
33614	RKN14-2	RUSKIN 14 KV BUS 2	13.8	1	22.5	8.9	367	367	383
33615	SPR 14	SPRECHER 14 KV	13.8	1	27.3	6.4	367	367	383
33618	WLT14-1	WALNUT 14 KV BUS 1	13.8	1	38	21.9	367	367	383
33619	WLT14-2	WALNUT 14 KV BUS 2	13.8	1	38.4	18	367	367	383
33622	WPT 14	WESTPORT 14 KV	13.8	1	12.9	0.3	367	367	383
33623	WTN14-1	WEST TOWNE 14 KV BUS 1	13.8	1	20.6	5.5	367	367	383
33624	WTN14-2	WEST TOWNE 14 KV BUS 2	13.8	1	19.9	7.5	367	367	383
33625	WGA14-1	WINGRA 14 KV BUS 1	13.8	1	22.5	6.4	367	367	383
33626	WGA14-4	WINGRA 14 KV BUS 4	13.8	1	22.5	4.4	367	367	383
33627	TOK14-1	TOKAY 1	13.8	1	17.1	3.8	367	367	383
33633	HSN14-1	HANSON RD 13.8	13.8	1	19.1	4.8	367	367	383
33926	LCI 14	LCI 13.8	13.8	1	11.4	1.4	367	367	383
38676	RYS 69	ROYSTER 69 KV	69	1	3.2	0.5	367	367	383
38678	MEN 69	MENDOTA 69 KV	69	1	4.3	0.5	367	367	383
38683	PFL 69	PFLAUM 69 KV	69	1	2.3	0.5	367	367	383
39180	WCP CT1	WEST CAMPUS CT1	13.4	1	5.5	3.5	367	367	383
39181	WCP CT2	WEST CAMPUS CT2	13.4	1	5.5	3.5	367	367	383
39822	FCH 14-1	FITCHBURG 14 KV BUS 1	13.8	1	30.3	5.8	367	367	383
39823	FCH 14-2	FITCHBURG 14 KV BUS 2	13.8	1	26.5	6	367	367	383
39825	HKP 14	HUISKAMP 14 KV	13.8	1	9.7	1.8	367	367	383
39826	WMD14-7	WEST MIDDLETON 14 KV BUS 3	13.8	1	8.4	2.3	367	367	383
39827	WMD14-8	WEST MIDDLETON 14 KV BUS 4	13.8	1	14.7	4.2	367	367	383
39835	SYC 14-1	SYCAMORE 14 KV BUS 1	13.8	1	15.4	5.7	367	367	383
39836	SYC 14-2	SYCAMORE 14 KV BUS 2	13.8	1	12.7	4	367	367	383
39852	NSP 14-1	NINE SPRINGS 14 KV BUS 1	13.8	1	14.1	4.4	367	367	383
39860	BLT 14	BLOUNT 14 KV	13.8	0	0	0	367	367	383
39860	BLT 14	BLOUNT 14 KV	13.8	1	12.1	1.2	367	367	383
39860	BLT 14	BLOUNT 14 KV	13.8	1	13	5.7	367	367	383
39861	BNT 14	BLOUNT NEW	13.8	1	27.5	6.9	367	367	383
					793	**246.9**			

Table C2 - Alliant (Dane County)

BUS#	NAME	SUBSTAION NAME	BSKV	ID	ST	MW	MVAR	AREA	ZONE	OWNER
33987	AMCNTR	AMERICAN CENTER ZERO TIE	138	1	1	7	3.1	364	371	383
38021	FOR 69	FORWARD	69	1	1	2.7	0.6	364	371	383
38039	BEE 69	BELLEVILLE	69	1	1	10	1.8	364	371	383
38129	MAZ 69	MAZOMANIE	69	1	1	3.5	3.5	364	371	383
38129	MAZ 69	MAZOMANIE	69	2	1	3.3	1	364	371	383
38130	BLE 69	BLACK EARTH	69	1	1	4.3	1.3	364	371	383
38132	TBL 69	TIMBERLANE	69	1	1	6.8	1.7	364	371	383
38134	MOH 69	MOUNT HOREB	69	1	1	8.8	2	364	371	383
38135	MH1 69	MOUNT HOREB MUNI #1	69	1	1	6.4	0.7	364	371	383
38136	PLV 138	PLEASANT VIEW	138	1	1	30.9	10.1	364	371	383
38137	VER 69	VERONA	69	1	1	17.9	4.5	364	371	383
38139	ORE 69	OREGON	69	1	1	19.6	5	364	371	383
38140	BYN 69	BROOKLYN	69	1	1	10.1	2.3	364	371	383
38141	NST 69	NORTH STOUGHTON	69	1	1	15.2	4.7	364	371	383
38144	CAM 138	CAMBRIDGE	138	1	1	11.9	2.8	364	371	383
38146	MCF 69	MCFARLAND	69	1	1	10.3	3	364	371	383
38147	COG 69	COTTAGE GROVE	69	1	1	12.2	2.5	364	371	383
38151	SUP 69	SUN PRAIRIE	69	1	1	5.9	1.3	364	371	383
38156	DEF 69	DE FOREST	69	1	1	10.5	1.3	364	371	383
38156	DEF 69	DE FOREST	69	2	1	17.7	6.8	364	371	383
38157	TOC 69	TOKEN CREEK	69	1	1	11.4	3.9	364	371	383
38159	BKE 69	BURKE	69	1	1	15.3	6.1	364	371	383
38160	DAN 69	DANE	69	1	1	4.7	2	364	371	383
38167	WTN 69	WEST TOWNE	69	1	1	23.4	5.7	364	371	383
39121	LDN 138	LONDON	138	1	1	6.3	0.2	364	371	383
39123	COD 138	COLLODAY POINT	138	1	1	9.1	1.7	364	371	383
39216	CCS 138	CROSS COUNTRY	138	1	1	9.2	2.8	364	371	383
39217	YAR 138	YAHARA RIVER	138	1	1	13.1	6.2	364	371	383
39221	GASTONRD	GASTON ROAD	69	1	1	5.5	1.2	364	371	383
39929	MZI 69	MAZOMANIE INDUSTRIAL	69	1	1	5.3	0.8	364	371	383
						318	**90.6**			

Table C3 - Wisconsin Public Power Incorporative (WPPI) and Wisconsin Energy (WE)

BUS#	NAME	SUBSTATION NAME	BSKV	ID	ST	MW	MVAR	AREA	ZONE	OWNER
38149	BRD 69	BIRD	69	1	1	12.6	2.7	365	380	383
38152	STH 69	SOUTH	69	1	1	14.1	5.6	365	380	383
38153	CDO 69	COLORADO	69	1	1	12.6	2.6	365	380	383
38161	BPK 69	BUSINESS PARK	69	1	1	7.9	2.9	365	380	383
38164	WE1 69	WAUNAKEE #1	69	1	1	8.9	2.5	365	380	383
38165	WE2 69	WAUNAKEE #2	69	1	1	5.6	1.8	365	380	383
38166	WPK 69	WAUNAKEE INDUSTRIAL PARK	69	1	1	9.8	6.3	365	380	383
38527	BOX ELDR	BOX ELDER	26.2	1	1	17.7	10.9	365	376	383
38142	STM 69	STOUGHTON MUNICIPAL	69	1	1	14.6	4.2	364	371	383
38143	STO 69	STOUGHTON	69	1	1	3	0.2	364	371	383
						107	40			

Total Dane County Load = 793+318+107 = 1218 MW

APPENDIX D – Dane County Coincident Peak Demand Summer 2009 (model built in 2004)

Table D1 - Madison Gas and Eclectic (MGE)

BUS#	NAME	SUBSTATION NAME	BSKV	ID	ST	MW	MVAR	AREA	ZONE	OWNER
33589	BLK14-2	BLACKHAWK2 13.8 KV	13.8	1	1	1	0.5	367	367	383
33590	BLK 14	BLACKHAWK 13.8 KV	13.8	1	1	29.5	5.9	367	367	383
33591	BLD14-1	BLOUNT 14 KV RADIAL	13.8	1	1	22.4	9.2	367	367	383
33592	BLD14-2	BLOUNT 14 KV RADIAL	13.8	1	1	7.5	1.7	367	367	383
33595	CSP 14	CROSS PLAINS 12.5 KV	12.5	1	1	6	1.1	367	367	383
33596	ECA14-1	EAST CAMPUS 14 KV BUS 1	13.8	1	1	19.9	10.1	367	367	383
33597	ECA14-2	EAST CAMPUS 14 KV BUS 2	13.8	1	1	24	8.2	367	367	383
33598	ETN14-1	EAST TOWNE 14 KV BUS 1	13.8	1	1	20.3	7.9	367	367	383
33599	ETN14-2	EAST TOWNE 14 KV BUS 2	13.8	1	1	15.1	4.7	367	367	383
33600	FEM14-3	FEMRITE 14 KV BUS 3	13.8	1	1	8.8	3.4	367	367	383
33601	FEM14-4	FEMRITE 14 KV BUS 4	13.8	1	1	12.9	2.3	367	367	383
33604	GWY 14	GATEWAY 14 KV	13.8	1	1	5	0.9	367	367	383
33606	HKP 14-2	HUISKAMP	13.8	1	1	14.8	2.7	367	367	383
33608	NSP 14-2	NINE SPRINGS 14 KV BUS 2	13.8	1	1	21.8	9.1	367	367	383
33609	PFL14-1	PFLAUM 14 KV BUS 1	13.8	1	1	18.5	3.3	367	367	383
33610	PHB 14	PHEASANT BRANCN 14 KV	13.8	1	1	31.3	10.2	367	367	383
33611	PHB 14-2	PHEASANT BRANCH	13.8	1	1	17.9	5.9	367	367	383
33612	RYS 14	ROYSTER 14 KV	13.8	1	1	17.5	5.2	367	367	383
33613	RKN14-1	RUSKIN 14 KV BUS 1	13.8	1	1	16.4	6.4	367	367	383
33614	RKN14-2	RUSKIN 14 KV BUS 2	13.8	1	1	26.5	10.3	367	367	383
33615	SPR 14	SPRECHER 14 KV	13.8	1	1	15.7	3.7	367	367	383
33618	WLT14-1	WALNUT 14 KV BUS 1	13.8	1	1	41.1	23.6	367	367	383
33619	WLT14-2	WALNUT 14 KV BUS 2	13.8	1	1	39.8	18.7	367	367	383
33622	WPT 14	WESTPORT 14 KV	13.8	1	1	13.9	0.3	367	367	383
33623	WTN14-1	WEST TOWNE 14 KV BUS 1	13.8	1	1	22.2	5.2	367	367	383
33624	WTN14-2	WEST TOWNE 14 KV BUS 2	13.8	1	1	21.4	7.5	367	367	383
33625	WGA14-1	WINGRA 14 KV BUS 1	13.8	1	1	24.7	7.5	367	367	383
33626	WGA14-4	WINGRA 14 KV BUS 4	13.8	1	1	24.2	4.7	367	367	383
33627	TOK14-1	TOKAY 1	13.8	1	1	19.8	4.9	367	367	383
33631	SFH14-1	OAK RIDGE 13.8-1	13.8	1	1	16.4	4.1	367	367	383
33632	SPR14-2	SPRECHER 14 KV BUS 2	13.8	1	1	13	3.3	367	367	383
33633	HSN14-1	HANSON RD 13.8	13.8	1	1	14.9	3.7	367	367	383
38676	RYS 69	ROYSTER 69 KV	69	4	1	3.4	0.5	367	367	383
38678	MEN 69	MENDOTA 69 KV	69	4	1	4.5	0.5	367	367	383
38681	LCI 69	AGA GAS 69 KV	69	1	1	11.1	1.4	367	367	383
38683	PFL 69	PFLAUM 69 KV	69	4	1	2.5	0.6	367	367	383
39180	IC29 CT1	WEST CAMPUS CT1	13.8	9	1	9.1	5.7	367	367	383
39181	IC29 CT2	WEST CAMPUS CT2	13.8	9	1	9.1	5.7	367	367	383
39814	WCP 12.5	WEST CROSS PLAINS	12.5	1	1	5.4	1.4	367	367	383
39822	FCH 14-1	FITCHBURG 14 KV BUS 1	13.8	1	1	32.9	6	367	367	383
39823	FCH 14-2	FITCHBURG 14 KV BUS 2	13.8	1	1	28.3	6.5	367	367	383
39825	HKP 14	HUISKAMP 14 KV	13.8	1	1	10.5	1.9	367	367	383
39826	WMD14-7	WEST MIDDLETON 14 KV BUS 3	13.8	1	1	9.3	2.6	367	367	383
39827	WMD14-8	WEST MIDDLETON 14 KV BUS 4	13.8	1	1	16	4.6	367	367	383
39835	SYC 14-1	SYCAMORE 14 KV BUS 1	13.8	1	1	16.6	6.1	367	367	383
39836	SYC 14-2	SYCAMORE 14 KV BUS 2	13.8	1	1	13.6	4.3	367	367	383
39842	ECA14-3	EAST CAMPUS 3RD	13.8	1	1	20.5	5.1	367	367	383
39844	SNP14-1	SOUTH NINE SPRINGS 13.8	13.8	1	1	10.9	2.7	367	367	383
39852	NSP 14-1	NINE SPRINGS 14 KV BUS 1	13.8	1	1	11.6	3.6	367	367	383
39861	BNT 14	BLOUNT NEW	13.8	1	1	37	14.4	367	367	383
39861	BNT 14	BLOUNT NEW	13.8	4	1	1	0.5	367	367	383
39861	BNT 14	BLOUNT NEW	13.8	5	1	1	0.5	367	367	383
						859	**270.8**			

Table D2 - Alliant (Dane County)

BUS#	NAME	SUBSTATION NAME	BSKV	ID	ST	MW	MVAR	AREA	ZONE	OWNER
33991	ABS	ABS	138	1	1	7.3	3.1	364	371	383
33992	AMERCNTR	AMERICAN CENTER	138	1	1	7	3.4	364	371	383
38021	FOR 69	FORWARD	69	1	1	2.4	0.3	364	371	383
38039	BEE 69	BELLEVILLE	69	1	1	10.7	2.8	364	371	383
38129	MAZ 69	MAZOMANIE	69	1	1	3.5	3.1	364	371	383
38129	MAZ 69	MAZOMANIE	69	2	1	3.2	1.1	364	371	383
38130	BLE 69	BLACK EARTH	69	1	1	4.3	1.7	364	371	383
38132	TBL 69	TIMBERLANE	69	1	1	10.7	3.4	364	371	383
38134	MOH 69	MOUNT HOREB	69	1	1	10.6	3.6	364	371	383
38135	MH1 69	MOUNT HOREB MUNI #1	69	1	1	4.1	0.4	364	371	383
38136	PLV 138	PLEASANT VIEW	138	1	1	30.7	11.8	364	371	383
38137	VER 69	VERONA	69	1	1	21.7	5.4	364	371	383
38139	ORE 69	OREGON	69	1	1	20	5.9	364	371	383
38140	BYN 69	BROOKLYN	69	1	1	9.2	2.6	364	371	383
38143	STO 69	STOUGHTON	69	1	1	3	0.8	364	371	383
38144	CAM 138	CAMBRIDGE	138	1	1	12.4	3.6	364	371	383
38146	MCF_138	MCFARLAND	138	1	1	15.7	4.8	364	371	383
38147	COG 69	COTTAGE GROVE	69	1	1	13.7	4.4	364	371	383
38151	SUP 69	SUN PRAIRIE	69	1	1	6.4	2.2	364	371	383
38156	DEF 69	DE FOREST	69	1	1	14.5	4	364	371	383
38156	DEF 69	DE FOREST	69	2	1	15.2	7.8	364	371	383
38157	TOC 69	TOKEN CREEK	69	1	1	12.1	4.2	364	371	383
38159	BKE 69	BURKE	69	1	1	10.9	4.5	364	371	383
38160	DAN 69	DANE	69	1	1	4.5	2	364	371	383
38167	WTN 69	WEST TOWNE	69	1	1	21.1	6.6	364	371	383
39121	LDN 138	LONDON	138	1	1	7	1.7	364	371	383
39121	LDN 138	LONDON	138	2	1	9.2	3.5	364	371	383
39123	COD 138	COLLODAY POINT	138	1	1	6.8	1.9	364	371	383
39216	CCS 138	CROSS COUNTRY	138	1	1	8.5	3	364	371	383
39217	YAR 138	YAHARA RIVER	138	1	1	13.4	6.7	364	371	383
39221	GASTONRD	GASTON ROAD	69	1	1	6.2	2	364	371	383
39929	MZI 69	MAZOMANIE INDUSTRIAL	69	1	1	5.7	1.4	364	371	383
						332	**113.7**			

Table D3 - Wisconsin Public Power Incorporative (WPPI) and Wisconsin Energy (WE)

BUS#	NAME	SUBSTATION NAME	BSKV	ID	ST	MW	MVAR	AREA	ZONE	OWNER
38141	NST 69	NORTH STOUGHTON	69	1	1	7	3.2	365	380	383
38142	STM 69	STOUGHTON MUNICIPAL	69	1	1	20.5	7.7	365	380	383
38149	BRD 69	BIRD	69	1	1	7.7	1.7	365	380	383
38152	STH 69	SOUTH	69	1	1	8.6	3.4	365	380	383
38153	CDO 69	COLORADO	69	1	1	7.7	1.6	365	380	383
38161	BPK 69	BUSINESS PARK	69	1	1	4.8	1.7	365	380	383
38164	WE1 69	WAUNAKEE #1	69	1	1	7.6	2.1	365	380	383
38165	WE2 69	WAUNAKEE #2	69	1	1	5.1	1.8	365	380	383
38166	WPK 69	WAUNAKEE INDUSTRIAL PARK	69	1	1	8.5	5.9	365	380	383
38527	BOX ELDR	BOX ELDER	26.2	1	1	11.8	0.8	365	376	383
						89.3	**29.9**			

Total Dane County Load (2009) = 859+332+89 = 1280 MW

APPENDIX E – Dane County Coincident Peak Demand Summer 2010 (model built in 2005)

Table E1 - - Madison Gas and Eclectic (MGE)

BUS#	NAME	SUBSTATION NAME	BSKV	ID	ST	MW	MVAR	AREA	ZONE	OWNER
33590	BLK 14	BLACKHAWK 13.8 KV	13.8	1	1	16.6	3.1	367	367	383
33591	BLD14-1	BLOUNT 14 KV RADIAL	13.8	1	1	26.5	10.9	367	367	383
33592	BLD14-2	BLOUNT 14 KV RADIAL	13.8	1	1	21.1	4.7	367	367	383
33595	CSP 14	CROSS PLAINS 12.5 KV	12.5	1	1	5.3	1	367	367	383
33596	ECA14-1	EAST CAMPUS 14 KV BUS 1	13.8	1	1	24.3	12.3	367	367	383
33597	ECA14-2	EAST CAMPUS 14 KV BUS 2	13.8	1	1	30.3	10.7	367	367	383
33598	ETN14-1	EAST TOWNE 14 KV BUS 1	13.8	1	1	20.6	8	367	367	383
33599	ETN14-2	EAST TOWNE 14 KV BUS 2	13.8	1	1	13.5	4.1	367	367	383
33600	FEM14-3	FEMRITE 14 KV BUS 3	13.8	1	1	11.1	4.3	367	367	383
33601	FEM14-4	FEMRITE 14 KV BUS 4	13.8	1	1	15.9	2.8	367	367	383
33604	GWY 14	GATEWAY 14 KV	13.8	1	1	5.1	0.9	367	367	383
33606	HKP 14-2	HUISKAMP	13.8	1	1	15	2.7	367	367	383
33608	NSP 14-2	NINE SPRINGS 14 KV BUS 2	13.8	1	1	26.5	11.1	367	367	383
33609	PFL14-1	PFLAUM 14 KV BUS 1	13.8	1	1	18.9	3.3	367	367	383
33610	PHB 14	PHEASANT BRANCN 14 KV	13.8	1	1	33.5	11	367	367	383
33611	PHB 14-2	PHEASANT BRANCH	13.8	1	1	19.4	6.4	367	367	383
33612	RYS 14	ROYSTER 14 KV	13.8	1	1	17.7	5.3	367	367	383
33613	RKN14-1	RUSKIN 14 KV BUS 1	13.8	1	1	18	7	367	367	383
33614	RKN14-2	RUSKIN 14 KV BUS 2	13.8	1	1	24.6	9.7	367	367	383
33615	SPR 14	SPRECHER 14 KV	13.8	1	1	19	4.4	367	367	383
33618	WLT14-1	WALNUT 14 KV BUS 1	13.8	1	1	30.4	17.5	367	367	383
33619	WLT14-2	WALNUT 14 KV BUS 2	13.8	1	1	30.8	14.4	367	367	383
33620	WLT14-3	WALNUT 14 KV BUS 3	13.8	1	1	29.3	7.3	367	367	383
33622	WPT 14	WESTPORT 14 KV	13.8	1	1	9.9	0.3	367	367	383
33623	WTN14-1	WEST TOWNE 14 KV BUS 1	13.8	1	1	22.6	6	367	367	383
33624	WTN14-2	WEST TOWNE 14 KV BUS 2	13.8	1	1	21.7	8.2	367	367	383
33625	WGA14-1	WINGRA 14 KV BUS 1	13.8	1	1	24.6	7.1	367	367	383
33626	WGA14-4	WINGRA 14 KV BUS 4	13.8	1	1	24.6	4.8	367	367	383
33627	TOK14-1	TOKAY 1	13.8	1	1	18.7	4.2	367	367	383
33630	MTN14-1	OAK RIDGE 13.8-2	13.8	1	1	6.6	1.6	367	367	383
33633	HSN14-1	HANSON RD 13.8	13.8	1	1	22.2	5.5	367	367	383
33926	LCI 14	LCI 13.8	13.8	1	1	11.4	1.4	367	367	383
33938	SUN VLLY	LINCOLN ALLIANT	138	1	1	4.6	0.9	367	367	383
33991	ABS	ABS	138	1	1	10.2	3.2	367	367	383
38676	RYS 69	ROYSTER 69 KV	69	4	1	3.3	0.5	367	367	383
38683	PFL 69	PFLAUM 69 KV	69	4	1	2.3	0.5	367	367	383
39180	WCP CT1	WEST CAMPUS CT1	13.4	9	1	10.5	6.6	367	367	383
39181	WCP CT2	WEST CAMPUS CT2	13.4	9	1	10.5	6.6	367	367	383
39822	FCH 14-1	FITCHBURG 14 KV BUS 1	13.8	1	1	22.9	4.4	367	367	383
39823	FCH 14-2	FITCHBURG 14 KV BUS 2	13.8	1	1	18.8	4.3	367	367	383
39825	HKP 14	HUISKAMP 14 KV	13.8	1	1	10.7	1.9	367	367	383
39826	WMD14-7	WEST MIDDLETON 14 KV BUS 3	13.8	1	1	10.6	2.9	367	367	383
39827	WMD14-8	WEST MIDDLETON 14 KV BUS 4	13.8	1	1	15	4.3	367	367	383
39830	FCH14-3	FITCHBURG 14 KV BUS 3	13.8	1	1	20.5	5.1	367	367	383
39835	SYC 14-1	SYCAMORE 14 KV BUS 1	13.8	1	1	16.9	6.2	367	367	383
39836	SYC 14-2	SYCAMORE 14 KV BUS 2	13.8	1	1	13.9	4.4	367	367	383
39844	SNP14-1	SOUTH NINE SPRINGS 13.8	13.8	1	1	13.7	3.4	367	367	383
39852	NSP 14-1	NINE SPRINGS 14 KV BUS 1	13.8	1	1	5.7	1.8	367	367	383
39860	BLT 14	BLOUNT 14 KV	13.8	1	0	0	0	367	367	383
39860	BLT 14	BLOUNT 14 KV	13.8	4	1	12.2	1.2	367	367	383
39860	BLT 14	BLOUNT 14 KV	13.8	5	1	13.2	5.8	367	367	383
39861	BNT 14	BLOUNT NEW	13.8	1	1	30	7.5	367	367	383
						881	**274**			

Table E2 - Alliant (Dane County)

BUS#	NAME	SUBSTATION NAME	BSKV	ID	ST	MW	MVAR	AREA	ZONE	OWNER
33925	ABS	AMERICAN BREEDER SERVICE	138	1	1	1.1	0.5	364	371	383
33939	HAWK	HAWK	138	1	1	5.2	1.6	364	371	383
33940	OAK RDG	SUGAR RIVER	69	1	1	3.7	0.4	364	371	383
33987	AMCNTR	AMERICAN CENTER ZERO TIE	138	1	1	7.7	3.4	364	371	383
38021	FOR 69	FORWARD	69	1	1	2.8	0.7	364	371	383
38039	BEE 69	BELLEVILLE	69	1	1	8.5	1.1	364	371	383
38129	MAZ 69	MAZOMANIE	69	1	1	4.2	3.9	364	371	383
38129	MAZ 69	MAZOMANIE	69	2	1	3.4	1.1	364	371	383
38130	BLE 69	BLACK EARTH	69	1	1	4.6	1.5	364	371	383
38132	TBL 69	TIMBERLANE	69	1	1	8.3	2.8	364	371	383
38134	MOH 69	MOUNT HOREB	69	1	1	10.8	3.4	364	371	383
38135	MH1 69	MOUNT HOREB MUNI #1	69	1	1	7	0.7	364	371	383
38136	PLV 138	PLEASANT VIEW	138	1	1	35.8	13.6	364	371	383
38137	VER 69	VERONA	69	1	1	23.1	8.1	364	371	383
38139	ORE 69	OREGON	69	1	1	19.9	5.5	364	371	383
38140	BYN 69	BROOKLYN	69	1	1	12.7	4.1	364	371	383
38141	NST 69	NORTH STOUGHTON	69	1	1	15	4.7	364	371	383
38144	CAM 138	CAMBRIDGE	138	1	1	14	4.4	364	371	383
38146	MCF_138	MCFARLAND	138	1	1	12.7	4.7	364	371	383
38147	COG 69	COTTAGE GROVE	69	1	1	15.1	4.5	364	371	383
38151	SUP 69	SUN PRAIRIE	69	1	1	7.2	2.2	364	371	383
38156	DEF 69	DE FOREST	69	1	1	10.6	1.6	364	371	383
38156	DEF 69	DE FOREST	69	2	1	17.8	7.1	364	371	383
38157	TOC 69	TOKEN CREEK	69	1	1	14.4	6	364	371	383
38159	BKE 69	BURKE	69	1	1	19.7	9	364	371	383
38160	DAN 69	DANE	69	1	1	4.8	2.1	364	371	383
38167	WTN 69	WEST TOWNE	69	1	1	24	6.6	364	371	383
39121	LDN 138	LONDON	138	1	1	7.3	1	364	371	383
39123	COD 138	COLLODAY POINT	138	1	1	10.9	3.1	364	371	383
39216	CCS 138	CROSS COUNTRY	138	1	1	10.6	4.1	364	371	383
39217	YAR 138	YAHARA RIVER	138	1	1	13	6.3	364	371	383
39221	GASTONRD	GASTON ROAD	69	1	1	6.9	2.2	364	371	383
39929	MZI 69	MAZOMANIE INDUSTRIAL	69	1	1	5.2	0.9	364	371	383
						368	**123**			

Table E3 - Wisconsin Public Power Incorporative (WPPI) and Wisconsin Energy (WE)

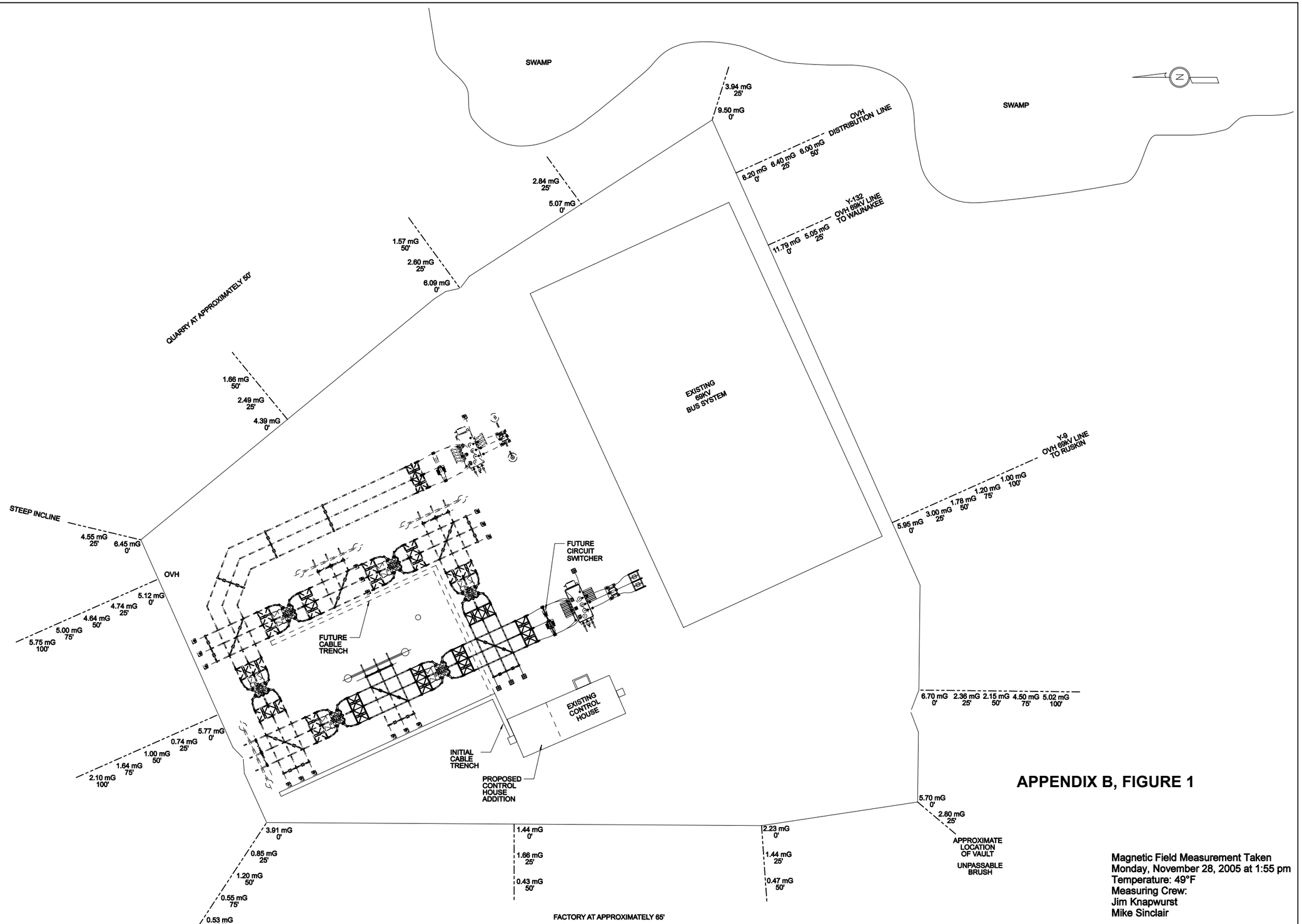
BUS#	NAME	SUBSTATION NAME	BSKV	ID	ST	MW	MVAR	AREA	ZONE	OWNER
38149	BRD 69	BIRD	69	1	1	13.9	3	365	380	383
38152	STH 69	SOUTH	69	1	1	15.5	6.1	365	380	383
38153	CDO 69	COLORADO	69	1	1	13.9	2.9	365	380	383
38161	BPK 69	BUSINESS PARK	69	1	1	8.6	3.1	365	380	383
38164	WE1 69	WAUNAKEE #1	69	1	1	10.9	3.1	365	380	383
38165	WE2 69	WAUNAKEE #2	69	1	1	6.9	2.1	365	380	383
38166	WPK 69	WAUNAKEE INDUSTRIAL PARK	69	1	1	12	7.7	365	380	383
38527	BOX ELDR	BOX ELDER	26.2	1	1	17.8	11	365	376	383
38142	STM 69	STOUGHTON MUNICIPAL	69	1	1	14.4	4.1	364	371	383
38143	STO 69	STOUGHTON	69	1	1	3.7	0.7	364	371	383
						118	**43.8**			

Total Dane County Load (2009) = 881+368+118 = 1367 MW

APPENDIX F – Dane County Generation

Table F1 - Generation Dispatch Scenarios – Year 2009

Power Flow Bus Number	Power Flow Bus Name	Substation Name	Primary Fuel Type	ID	Capability MW	Scenario	
						10a-09-04	20a-12-03
39860	BLT 14	Blount	Coal	4	22	22	22
39969	BLT G6	Blount	Coal	6	49	49	49
39968	BLT G7	Blount (Slack)	Coal	7	50	47	47
			Coal Total		121	118	118
33590	BLK 14	Blackhawk	Diesel	X	15	0	0
33598	ETN14-1	East Towne	Diesel	X	10	0	0
33614	RKN14-2	RUSKIN	Diesel	X	11	0	0
39826	WMD14-7	West Middleton	Diesel	X	10	0	0
			Diesel Total		46	0	0
39180	IC29 CT1	West Campus	Gas (Combined Cycle)	1	49	48	48
39181	IC29 CT2	West Campus	Gas (Combined Cycle)	1	49	48	48
39182	IC29 ST	West Campus	Steam Combined Cycle)	1	49	49	49
			Combined Cycle Total		147	145	145
39860	BLT 14	Blount	Gas (Peaker)	3	39	39	39
39860	BLT 14	Blount	Gas (Peaker)	5	29	28	28
39137	CHA1 18 18.0	Christiana	Gas (Peaker)	1	150	150	150
39138	CHA2 18 18.0	Christiana	Gas (Peaker)	2	150	150	150
39139	CHA3 18 18.0	Christiana	Gas (Peaker)	3	150	150	150
39822	FCH 14-1	Fitchburg	Gas (Peaker)	1	22	0	21
39823	FCH 14-2	Fitchburg	Gas (Peaker)	2	22	0	21
39852	NSP 14-1	Nine Spring	Gas (Peaker)	1	15	0	15
39835	SYC 14-1	Sycamore	Gas (Peaker)	1	14	0	13
39836	SYC 14-2	Sycamore	Gas (Peaker)	2	21	0	21
			Gas (Peaker) Total		612	517	608
			Grand Total		**926**	**780**	**871**



APPENDIX B, FIGURE 1

Magnetic Field Measurement Taken
Monday, November 28, 2005 at 1:55 pm
Temperature: 49°F
Measuring Crew:
Jim Knapwurst
Mike Sinclair

REV	DATE	W.O. #	DESCRIPTION	DRAWN	CHK'D	APP'D	CMPY
1	11-8-05		ADD NOTES				

SCALE
NTS
0

AMERICAN TRANSMISSION COMPANY
THE ENERGY ACCESS COMPANY

HUISKAMP SUBSTATION EMF READING
GENERAL DRAWING

ENGINEERING RECORD DRAWING NUMBER ER - 10 - 000059 - 025

$sytime$

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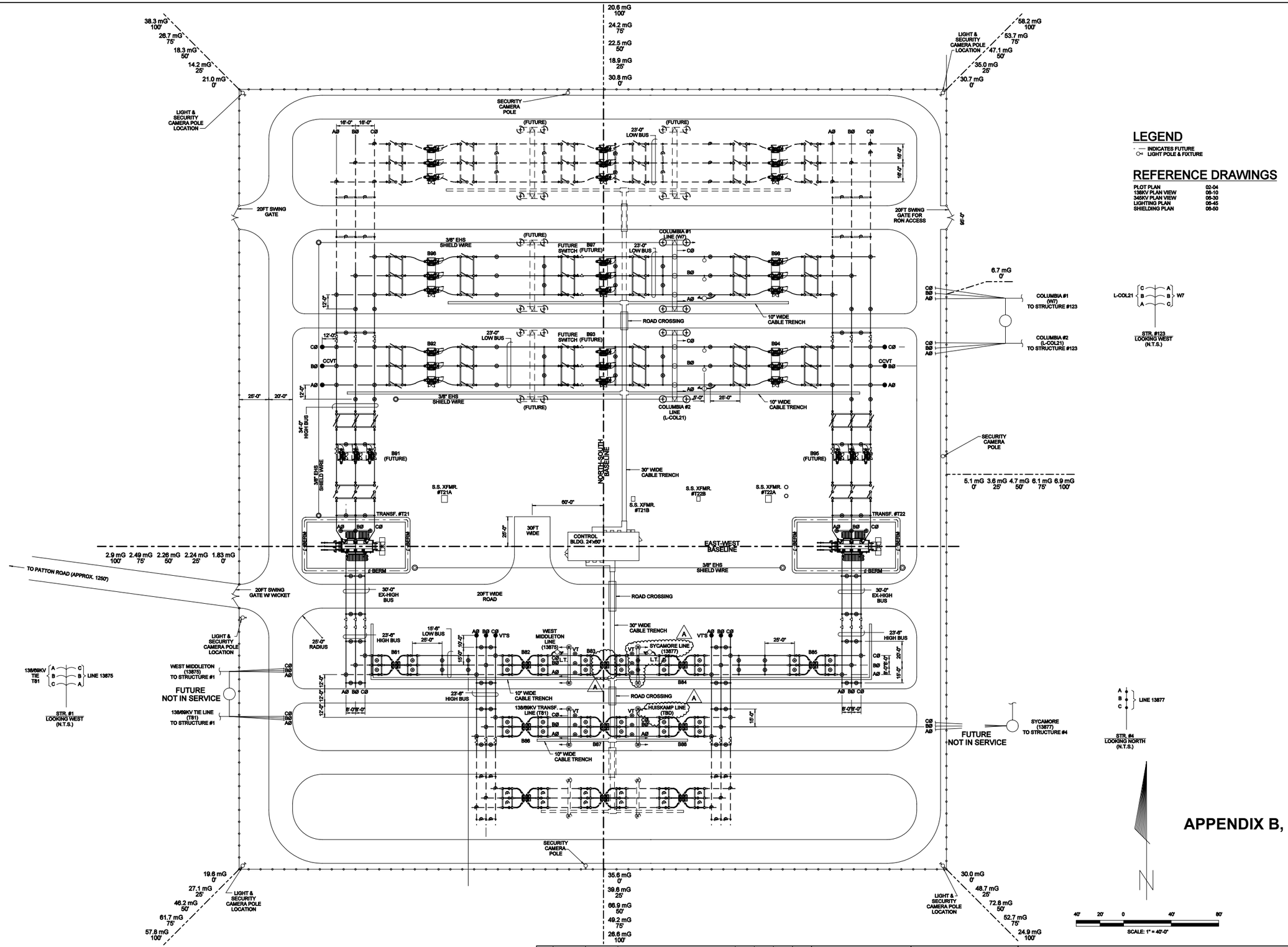

LEGEND

INDICATES FUTURE
LIGHT POLE & FIXTURE

REFERENCE DRAWINGS

PLOT PLAN	02-04
138KV PLAN VIEW	05-10
345KV PLAN VIEW	05-30
LIGHTING PLAN	05-45
SHIELDING PLAN	05-50

APPENDIX B, FIGURE 2

REV	DATE	W.O. #	DESCRIPTION	DRAWN	CHK'D	APP'D	CMPY
1	11-8-05		ADD NOTES				

SCALE: NTS

AMERICAN TRANSMISSION COMPANY
THE ENERGY ACCESS COMPANY

NORTH MADISON SUBSTATION EMF READING
GENERAL DRAWING

ENGINEERING RECORD DRAWING NUMBER ER - 10 - 000059 - 024

$sytime$

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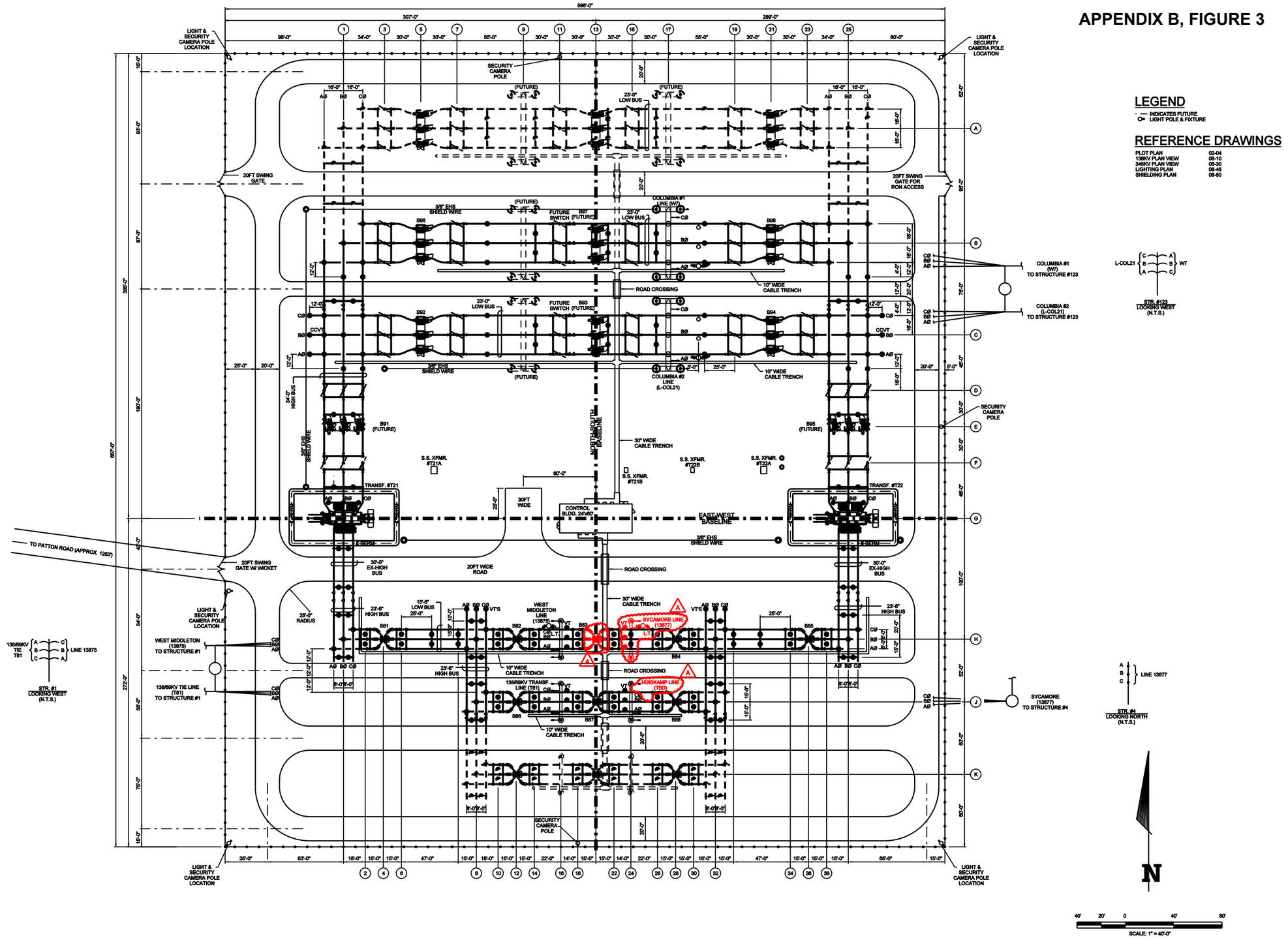
APPENDIX B, FIGURE 3



LEGEND

— INDICATES FUTURE
LIGHT POLE & FIXTURE

REFERENCE DRAWINGS

PLOT PLAN	02-04
138KV PLAN VIEW	06-10
345KV PLAN VIEW	06-30
LIGHTING PLAN	06-45
SHIELDING PLAN	06-50

REV	DATE	W.O. #	DESCRIPTION	DRAWN	CHK'D	APP'D	CMPY
A			ISSUED FOR REVIEW	DAK			ECI
0	2/25/05	61908	ISSUED FOR CONSTRUCTION	PEI	PEI		

AMERICAN TRANSMISSION COMPANY
THE ENERGY ACCESS COMPANY

ELECTRICAL GENERAL ARRANGEMENT

NORTH MADISON 345/138KV SUBSTATION

SCALE 1"=40'-0"

DRAWING No. NMA1 - 06 - 01

Revised

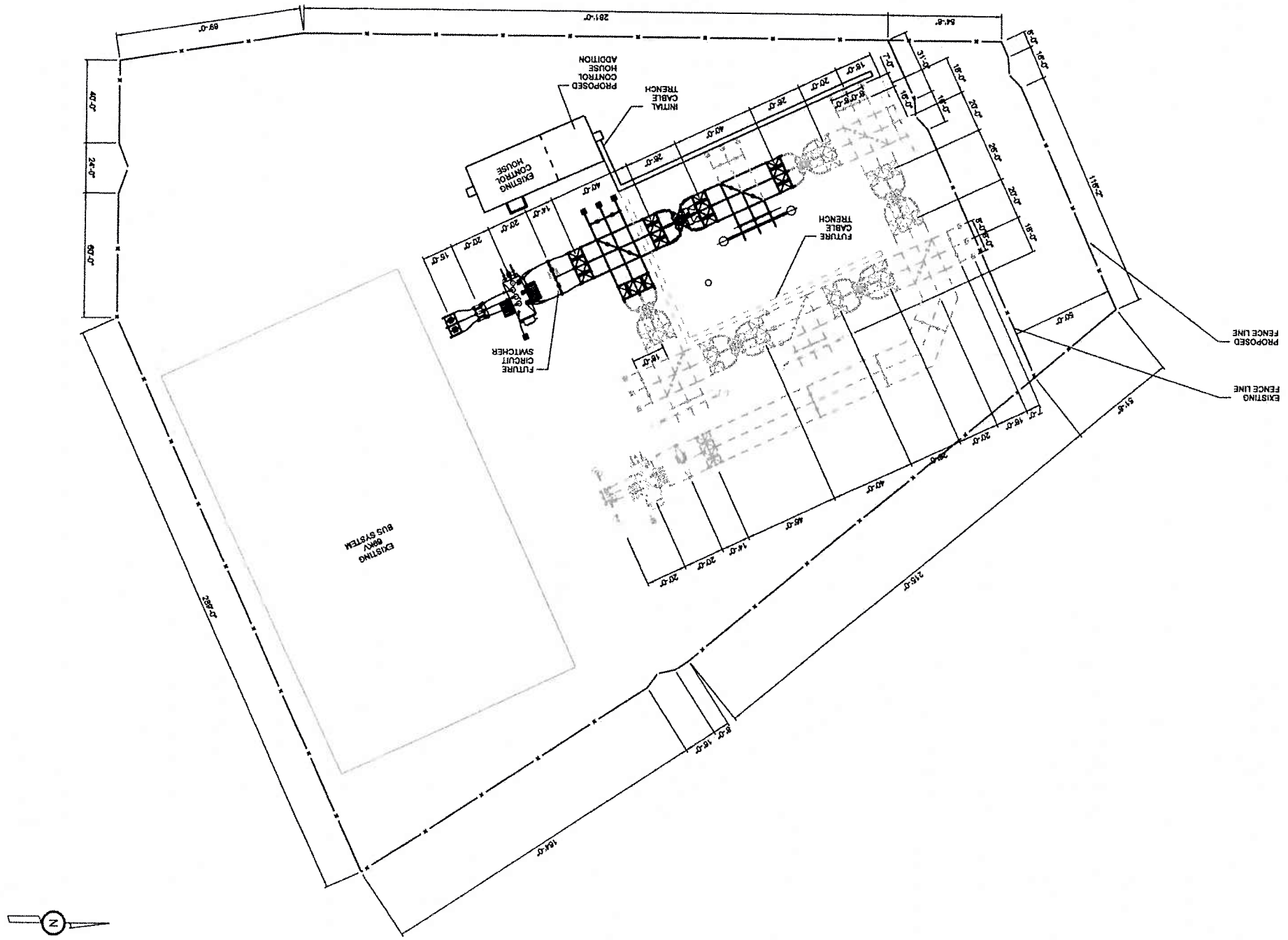
REV	DATE	W.O. #	DESCRIPTION	DRAWN	CHK'D	APP'D	CHIEF

AMERICAN TRANSMISSION COMPANY 2004

CONCEPTUAL DRAWING
GENERAL ELECTRICAL ARRANGEMENT
HUISKAMP SUBSTATION

DRAWING NO. HKP - 00 - 00

SCALE 1" = 30'



APPENDIX B, FIGURE 4